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POWER

FRED R. LOW, *Editor*

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The Man with the Alibi

A FAILURE with an alibi is a failure just the same.

Anybody can, with the necessary application, make a passable job of himself or of his task when the lines are all laid out, the path is smoothed, and helping hands are lending aid and willing friends are contributing support and encouragement.

But the fellow who will come through shining and be qualified to do things and fight the fight is the one who sticks when the job becomes hard, who can force his way through or around obstacles, find in each new difficulty a challenge and rise superior to it.

Abe Lincoln did not give up trying to educate himself because the candles gave out. He got a pine knot.

Learning meant more to him than an excuse for not getting it.

Some men spend more time and brains in hunting up excuses why a job that is becoming irksome cannot be done than would carry it through to a happy conclusion.

Some of the best work that has been done in science and invention, in engineering and industry, has been carried through under difficulties that would have been glorious alibis to the ordinary man.

And the habit of success, the ability to plan one's way through, to persevere through difficulties and discouragements is what makes a man a winner.

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

Byproduct Steam from the Power House

THE National District Heating Association on June 11 to 14 held its twentieth annual convention, a report of which is given in this number.

That the members of this association are keenly interested in the possibilities of combining central heating and the sale of steam to industry with the generation of electric power is evident from the data contained in committee reports and papers presented.

The operating committee, in a questionnaire sent to a number of typical companies, endeavored to determine the relations between the steam-heating and electrical departments with regard to generation of byproduct energy. Of the nine companies reporting, five generate byproduct power from steam used in the heating systems. A table of operating statistics indicates that seventeen out of thirty-eight central heating companies generate electric energy.

None of these companies, however, appears to have made any attempt to use byproduct steam from high-pressure electric generating plants for central heating purposes. The thermal advantages to be obtained from this combination were presented by A. A. Potter and indicate such a system to be justified as far as cycle efficiencies are concerned. This idea seems to hold forth some promise, and it may be that future high-pressure plants, when their location permits, will be designed to supply a central heating system with byproduct steam or, as in the case of the new Deepwater stations, supply process steam to industry.

Must the Engineer Adopt Snobbery?

IN AN address to the students of the Massachusetts Institute of Technology, Professor Rogers advised the embryo engineers to become snobs if they desired to succeed, whereupon the daily press gave the professor more publicity than could be obtained through a highly paid propaganda agent.

The gist of the advice was that, since the M.I.T. student was a highly educated person, he was a superior person and should so conduct himself as to inform the world of his superiority.

If this advice had been given by the head of a school for butlers or head waiters, it would have been sound. Nothing is so necessary for a person holding a menial position as the cultivation of an air of superiority. It dulls one's own feeling of inferiority and may impress the person on the doorstep or in front of the velvet rope.

Probably one of the main advantages of a higher schooling is that it teaches humility. The student at a technical school, while learning a little, comes to an understanding of how vast is the world of knowledge of which he has gained possession of but a few acres. When he compares the title he has to this insignificant estate, much of which is barren or swampy, with the holdings of a Kelvin, he has no spirit to practice snobbery—if he be an honest man.

A student leaving an engineering school to engage in the struggle for an opportunity to accomplish something worth while, should be impressed with the fact that, after all, the world holds only a few intrinsically superior people. The student is morally and intellectually but an average of mankind. His fund of information may be more extensive, but his basic intelligence is not greater than that of the man who jostles him in the subway. Then why attempt snobbery?

Regardless of the present tendency of business to welcome graduates, most industrial executives are dubious of the practical worth to them of the smattering of knowledge the college man brings with him. Nothing will do more to hinder the progress of a young engineer than this advised air of snobbery. This does not mean that the graduate should adopt the air or dress of a truck driver, but if he cannot mix with the drivers, as well as the department heads, without bringing a chill to the atmosphere, he may ultimately accumulated a bank roll, but that greater wealth—understanding of mankind—will never be attained.

Effect of Age on Water Rate of Steam Turbines

A RECENT inquiry asked the effect of age on the water rate of a certain type of steam turbine. Few data are available on this subject, although these must be contained in the records of the many central stations. Much would be gained through a wider knowledge of these data. Discussion would lead to more definite conclusions regarding some uncertain factors in steam-turbine construction and power-plant design and operation.

The presence of moisture due to expansion in the low-pressure section of condensing turbines leads, in certain types of blading, to rapid erosion of the inlet and outlet edges of the blades and also to pitting of other surfaces. The amount of this moisture present depends on the degree of initial superheat, the range of expansion, and the efficiency of the turbine. The

more efficient the turbine the greater the moisture content. Some attempts have been made to remove this moisture at low-pressure bleeding points, but the success of these methods is still debatable. One European designer has attempted centrifugal separation of the moisture and bypassing of the separated water through the later stages. This system has not been sufficiently proved to date.

While every turbine builder has ideas regarding the maximum allowable moisture content in exhaust steam for best operation and longest life of blading, few plant designers and operating engineers have definite knowledge of those most desirable limits. As a result undesirable steam conditions are frequently specified which lead to heavy maintenance charges on the low-pressure blading after a short period of use. The initial choice of a higher superheat would have greatly lessened this trouble.

There is another phase to this problem. Erosion by moisture in low-pressure steam appears to be proportional to steam velocities. This would indicate that low steam velocities are desirable in such blading. On the other hand, the size of turbine frequently necessitates the use of the largest allowable wheels and of high steam velocities to pass the steam through the last stage at full load. The resultant maintenance charges from erosion when capitalized may exceed the extra cost that would have resulted from the use of double-flow or other forms of blading. Possibly certain of these forms of blading for exhaust end use may possess advantages in this regard not generally recognized by power-plant engineers.

A prominent European engineer has stated that the moisture in the turbine exhaust should not exceed from seven to ten per cent. Many American turbines operate with percentages of moisture in the exhaust that considerably exceed these figures. Does this lead to unnecessarily high maintenance charges on low-pressure blading and to sacrifices in economy due to the decrease in efficiency from erosion with increase of age?

Educational Policy a Factor in Engineer's Earnings

ENGINEERS earn less than equally well equipped men in many other professions. The situation is often blamed on the engineer's typical weakness—his lack of ability to "sell" himself and the value of his work. This undoubtedly has much to do with the low earning capacity of the average consulting engineer, as compared, for example, with that of the physician or lawyer of equal technical skill. Too often those who could profit from his services fail to do so because they think they can muddle along well enough without him. The lawyer says, "He who is his own lawyer has a fool for a client," and the public has learned that this is generally true. The consulting engineer has not yet attained such a reputation, although he doubtless deserves it.

Yet it must not be forgotten that but a small proportion of engineers act as consultants. There are many jobs where the necessity of employing an engineer is taken for granted, and where salesmanship is a minor element in fixing the "market price." Plant engineers, operating engineers and designers employed by manufacturers should not blame their economic position entirely on lack of "front." Supply and demand play a larger part. The simple fact is that employers can obtain and hold men at the rates now offered. To put it bluntly, there are too many engineers. Fortunately, this oversupply promises to cure itself, to some extent at least, although the process must be gradual.

One of the main causes of the present situation has been the flood of engineering graduates turned out during the past twenty years. Two decades back engineering was extravagantly pictured as a bonanza to the young man seeking a career. The engineering colleges were flooded with students and attempted to grind out graduates on a quantity-production basis. Many of these graduates have now turned from engineering to other lines of work. News has drifted back to the high schools that engineering is not a short cut to riches. And finally, the colleges themselves have stiffened their courses and entrance requirements. The result is a healthy trend toward fewer and better engineers.

A better product, available in small quantities, must surely lead to a higher valuation, so that there is yet economic hope for the engineer.

Diesel Engineers Get Together

TODAY one can hardly read a newspaper without encountering a news item on Diesel-engine application to the airplane, truck or power plant. In all cases it has seemed necessary to the news editor to run a brief explanation of how the Diesel functions, although no such explanatory remarks are carried in the case of the steam engine or turbine. Apparently, the public is not so intimately acquainted with the oil engine as with its steam or gasoline counterpart.

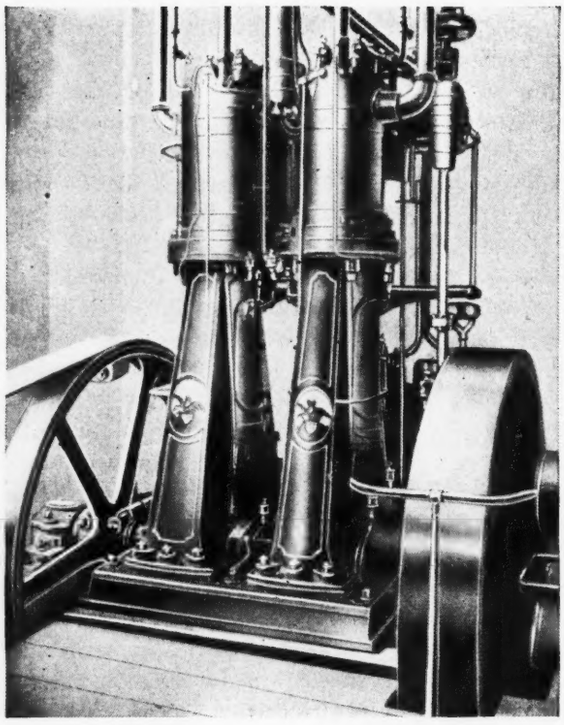
An identical reason, that of acquainting the engineering public with the Diesel engine, prompted a number of engineers to initiate an Oil Power Week, several years ago, during which time scores of meetings were held throughout the country to discuss the oil engine.

With the public impression made, it seemed desirable that the builders and designers, as well as the owners of oil engines, have a forum in which their problems could be discussed by competent authorities. This led to the first National Oil Power Conference held at Pennsylvania State College last year. Success was so evident that this week the Second Conference is being held at the same college.

The conference bears every earmark of being a successful one and it is hoped that the yearly meeting will become established, even though its location be shifted among the various technical schools.

EARLY HISTORY *of the Diesel Engine*

BY L. H. MORRISON
Associate Editor

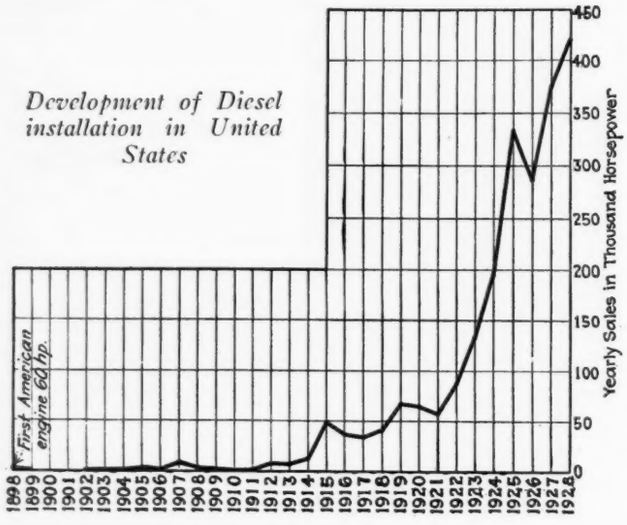


The first Diesel put into commercial operation

CONTRARY to the prevailing impression, America has taken a prominent part in the development of the Diesel, or self-ignition, engine. It is true that most of the purely research activity has made itself evident in Europe, but it is in the United States that the actual building of Diesels has been placed on a production basis, until the total yearly American output exceeds that of any other country. In addition, the firm building the greatest number of oil engines each year is in this country; this builder sold over 160,000 hp. in 1928.

The fact that sales of engines were very sluggish until 1912 is traceable to two factors—the opposition that every revolutionary process or machine encounters, and the exclusive possession of the American patent rights by a single company.

According to the impressions of the day the Diesel patents expired in 1912, which led to other firms immediately embarking upon the construction of high-compression engines when that date was reached. By 1917 a number of manufacturers were vigorously campaigning for orders. Most of these units were under 500 hp. and above 100 hp., for the contemporaneous development of the hot-bulb engine, with its lower manufacturing costs, practically held control of the small-engine market.



Development of Diesel installation in United States

The World War gave an impetus to the Diesel manufacturing which, save for a brief post-war depression, continued until in 1928 there were 440,000 hp. of Diesel engines built in the United States, making the total installed since 1898, 2,260,000 horsepower.

High-compression, self-ignition engines now being built in the United States, to which the generic name of "Diesel engine" is applied, are the outcome of two parallel developments. One group of American Diesels derived from the original idea of Doctor Diesel himself, while the other group started with a low-compression, hot-bulb engine built in the United States in 1893 and gradually developed here to its present design through successive increases in compression and improvement in combustion systems.

So frequently has the statement been made that the Diesel first came into commerical use in Germany that seldom is the claim challenged. History, however, reveals that the first Diesel engine to be put into regular power service was a 60-hp. unit built in St. Louis, Mo., in 1898, after Doctor Diesel's design.

The story of how the Diesel came to America is an interesting study of one man's determination to carry out a plan once started.

Adolphus Busch, head of the famous Anheuser-Busch Brewery, St. Louis, Mo., spent a part of each year in Germany, the home of his ancestors. One of his closest friends was Baron Von Krupp, and during the 1890's Von Krupp was continually discussing the experiments Doctor Diesel was carrying on dealing with an engine that was to burn a heavy cheap oil. Mr. Busch felt that such an engine would supply need for cheap power in America's small factories. Doctor Lauster, now director of M.A.N. and then assisting Doctor Diesel, was equally enthusiastic over the engine's potential value.

Col. E. D. Meier, a friend of Mr. Busch, had already introduced the Heine water-tube boiler into the United States, and this success made any opinion he might form of increased value. Mr. Busch turned to him for advice and, after he had thoroughly investigated the work going on, Colonel Meier conceded that the engine possessed heretofore undreamed-of merits, even though it was still in the experimental stage.

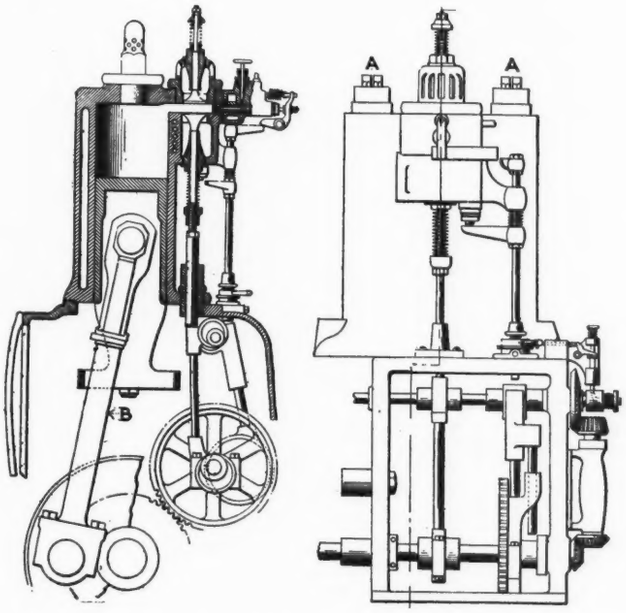
Busch speedily began serious negotiations and finally purchased the American rights for $250,000, his protection against competition being the American patents granted Doctor Diesel, dated 1895. These patents were assumed to run until 1912, but actually, owing to some confusion in the application, expired in 1906. This, however, was not discovered until later and was held a secret among the company officials. The humor lies in the patience with which many manufacturers awaited the arrival of 1912 before engaging in Diesel building.

On his return to the United States in 1896 Adolphus Busch formed the Diesel Motor Company of America, of which Col. E. D. Meier was made president, Hugo Reisinger, secretary and treasurer, and A. J. Frith, chief engineer.

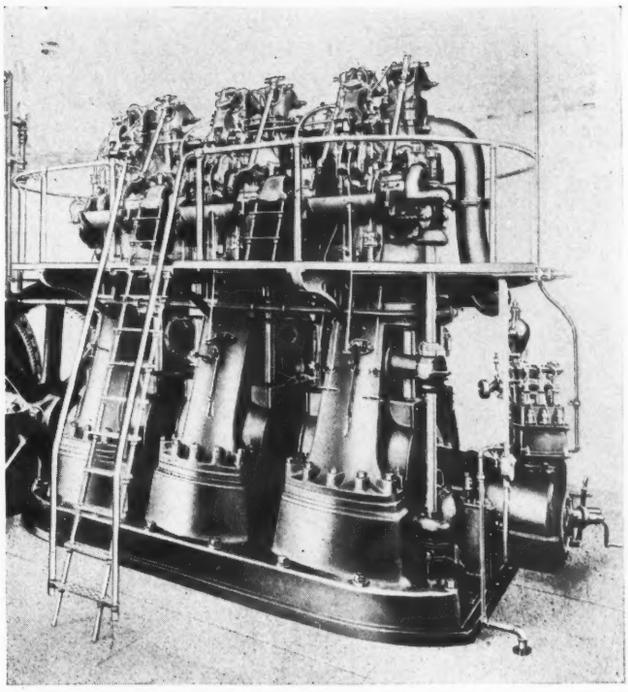
Mr. Frith was more of a theorist than a practical engineer, and while he had a deep understanding of thermodynamics, was not a machine designer of deep experience. It fell upon the shoulders of J. D. McPherson, an old marine engineer, to assist Frith in the evolution of a workable engine from Doctor Diesel's claims.

During the early stages of starting the new company, Mr. Busch had a two-cylinder A-frame engine built for him from the design that the Krupps works had developed. This engine, shown in the headpiece, closely follows the design of the engine exhibited by Krupps at the Munich exposition in 1898.

It was early recognized that the German design possessed undesirable features, consequently Frith and McPherson evolved and patented an entirely new engine, including a box frame, a horizontal fuel valve, direct-connected air compressors and a novel valve gear which enabled the engine to start on air on the two-cycle principles.



The design first used with two compressors A, *driven from the piston at* B



The Diesel designed by Norman McCarty

Mention must be made of the splash oiling system. This was copied from the arrangement used on the Westinghouse vertical gas and steam engines. The base was filled with water up to a level at which the big ends of the connecting rod struck the surface; to this water was then added about two inches of lubricating oil. Lubrication of all bearings, crankshaft, crankpin and wristpin, was obtained in this way. The builders continued to adhere to this system up to the day the entire engine design was discarded in 1912.

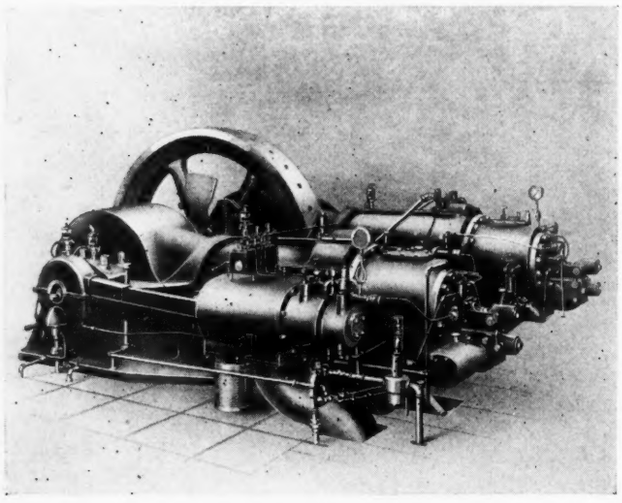
Frith seemed to have anticipated the work of many present-day Diesel designers who are attempting to consolidate the air charge into a compact mass. In one patent, dated March 6, 1900, he pointed out the desirability of massing the clearance air into a cavity in the cylinder head. This design was probably the result rather than the cause of placing the spray valve in the horizontal position.

Each working cylinder had its own injection-air supply, obtained from two $1\frac{1}{2}$x20-in. single-acting compressor cylinders housed in the same casting as the working cylinder. The compressor plungers were connected to lugs on the lower end of the engine piston. Bottles for the injection and starting air were placed in the engine base, and the two compressors led to them, which tended to equalize the pressure in the air piping.

Westinghouse influence, apparently, was of much weight, for the cylinder head followed the general plan of that used on the former's gas engine, with the fuel-spray valve inserted in the igniter opening. This general head design was adhered to until 1912 in spite of the fact that the exhaust bridge was a constant source of trouble, for fractures developed in many heads.

The actual Diesel was developed and built at the Hewes & Phillips Iron Works, Newark, N. J. But one size of engine was built, with a 11x20-in. cylinder, which, when running 200 r.p.m., was intended to develop 20 hp. This worked out as calling for approximately 42 lb. brake m.e.p. and about 50 lb. indicated m.e.p.

Normal McCarty, who became sales manager for the Diesel Motor Company in 1900, sold two of these 20-hp. Diesels to the Long Arm System Company, Cleveland, Ohio, builders of marine bulkhead doors. After a few weeks' service trouble developed in the air compressor. Because of the high compression ratio of 90, the intense heat developed in single-stage operation would explode



A two-stroke-cycle Diesel engine built by Standard Fuel Oil Engine Co.

the lubricating oil, and the resulting enormous pressure promptly broke the driving lugs on the working cylinders. The fuel consumption proved to be high, traceable to the horizontal position of the spray valve. Little was known of spray-valve design, so no attempt was made to set up a resistance in the atomizer, and the oil and air passed through a set of $\frac{1}{8}$-in. holes in the end of the atomizer sleeve. It is not surprising that this pioneer engine would empty the entire valve body of its oil charge by the induction action of the injection air.

For six months there was a constant stream of repair parts moving to Cleveland, and finally Mr. Busch lost his faith in the ability of American factories to build Diesels. It was decided to quit trying to manufacture the engines and import them from Germany. Mr. Frith left the company, becoming associated with Armour Institute at Chicago in 1909, where he died in 1914.

McCarty seemed to possess engineering ideas as well as salesmanship. At his suggestion the compressor pistons were removed from one of the Cleveland engines, and a three-stage independent compressor was installed to supply the injection air. The air bottles were also taken from the engine frame. Operating difficulties largely disappeared as soon as these alterations were made.

No further progress was registered for some six months, at which time Joseph H. Hoadley, who had organized the American & British Manufacturing Company at Providence, R. I., approached Mr. Busch with a new manufacturing and sales plan. His suggestion was that the engine be redesigned to overcome the difficulties experienced with the early units and be built on a contract basis by his firm. Sales were to be made on an installment saving plan, which had proved so successful in Corliss-engine manufacture.

Mr. Busch formed a new sales organization, calling it the New York & New Jersey Diesel Power Company. McCarty was made sales manager, and McPherson went to Providence, where he was to assist Walter Knight, Hoadley's chief engineer, in working out the new design. As Knight was a wealthy man, he devoted little time to the factory, so the new engine must be regarded as the product of McPherson's engineering brain and he must be regarded as the first real Diesel designer.

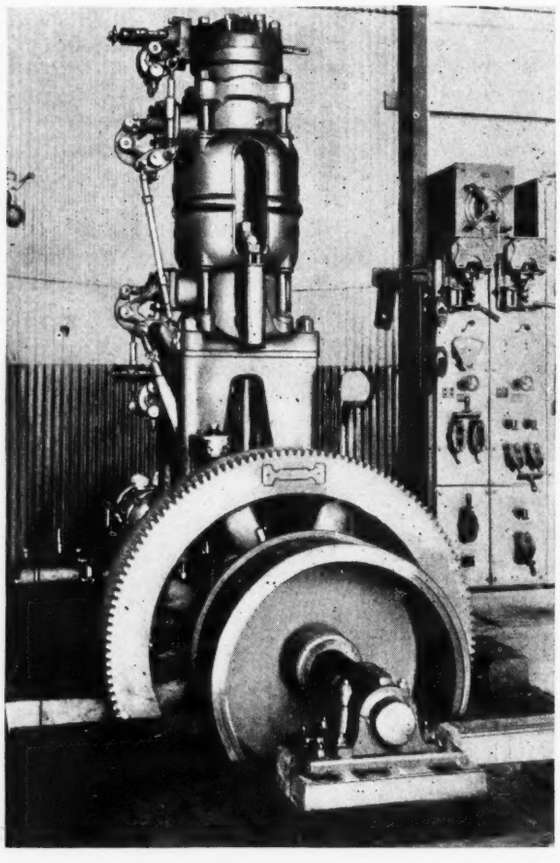
This engine was afterward called the type A and was the only Diesel design used in America until 1912.

Four cylinder sizes were developed, each engine having three cylinders. The capacities of various units are shown in the tabulation:

	CYLINDERS		
Diameter and Stroke, In.	No. of Cyl.	Rev. per Min.	Brake Hp.
10x15	3	250	75
12x18	3	225	120
14x21	3	200	170
16x24	3	165	225

The saving sales plan, however, was never carried out, and Busch formed the American Diesel Engine Company, with McPherson as chief engineer.

One unusual feature of these engines was the automatic intake, or admission, valve used on the 10x15-in. cylinder. This actually functioned satisfactorily and

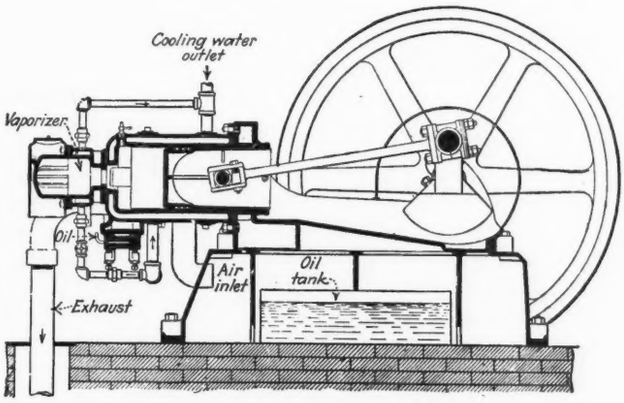


America's first double-acting Diesel

there is a 10x15-in. unit still in service at the Fulton Foundry, Brooklyn, N. Y., although it was built in 1903; the larger engines had pushrod-operated admission valves. A second feature was an attempt to obtain combustion at constant temperature by shaping the fuel cam so that the flow of oil after the initial jet gradually decreased.

The first of these Diesels to be installed were two 10x15-in. at the Jewett City, Conn., municipal light plant in 1903. A few of the 12x18-in. and 14x21-in. engines were sold, but the demand was for larger units.

After the exhibition of three 16x24-in. engines at the St. Louis World's Fair in 1904, the Providence plant was kept busy on this size of engine. Many installations were made of two three-cylinder engines coupled to a single generator swung between the two frames, notably sixteen double sets installed in a phosphate mine at Mulberry, Florida. To relieve the overtaxed factory, a



The early Hornsby-Ackroyd vaporizer engine

number were built by the Power & Mining Machinery Company, Cudahy, Wis., afterward a part of the Worthington Pump & Machinery Corporation.

Although many engines were being sold, the financial condition of the company was unsatisfactory. The American & British Manufacturing Company was being paid $50 per horsepower and the Diesel company was selling them for $60. The margin was not enough to leave any profit. This led Mr. Busch to take over the organization and form a new firm, "Adolphus Busch, Incorporated." The company continued until a demand for a more advanced design and size, as well as the likelihood of competition from others preparing to build engines, led Mr. Busch to open negotiations with Sulzer Bros., of Switzerland, in 1912. It will be noticed that up to this time the Diesel design used was purely American.

Mr. Harris, the general manager, and McPherson went to Switzerland to become familiar with the Sulzer design. Mr. McPherson became sick and returned to New York where he died. The result of the negotiation was the formation of the Busch-Sulzer Bros. Diesel Engine Company, of which Max Rotter became chief engineer. The company erected a new factory in St. Louis and began the building of box-frame four-stroke-cycle and later two-stroke-cycle Diesels after Sulzer Bros. designs. At present this firm builds Diesels up to 4,000 hp. in six cylinders at 125 r.p.m.

Earliest Large Engine

In the meantime McCarty was convinced that the trade demanded a larger engine, so he entered into an engagement with the Atlas Engine Works to design what was to be the largest cylinder in America. This was an exhibition of optimism, for the company was in the hands of a creditors' committee, a thing not hopeful to the development of any engine. The cylinder, as developed in 1910, had a bore of 21 in. and a stroke of 30 in. and was rated at 175 hp. per cylinder at 180 r.p.m. The valves were driven by eccentrics through toe cams to give quick opening and closing; pistons and exhaust valves were water-cooled and the old American Diesel idea of adjustable main bearings was incorporated in the design. Strangely, McCarty used the A-frame, although he was in part responsible for the American Diesel's box frame. One of the units, of 1,000 hp., installed in the Hawaiian Islands, was for a number of years the largest American-built Diesel.

As might be expected, the company came to a receivership and the purchaser reorganized it, changing the name to the Lyons Atlas Company.

Only a few of these engines were built, for they functioned poorly and the shop tools were entirely too small for such heavy work.

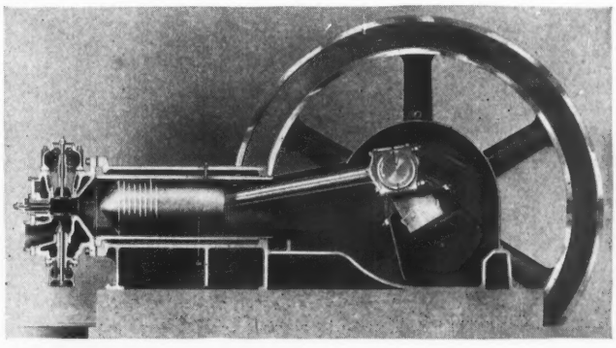
In 1915 the Midwest built a double-acting experimental Diesel after McCarty's designs, the first in America. This was unusual in that the cylinder ends were separate and no piston rod was used. One eccentric drove all the valves and an additional eccentric and Stephenson link gave a reversal similar to that of a marine steam engine. The cylinders were 11x15 in., and at 150 r.p.m. the engine developed 100 brake horsepower.

At about the same time the Brown Engine Company built a horizontal tandem double-acting Diesel. This was installed in a Florida plant, but was not a success.

Early Two-Stroke-Cycle Diesel

Still another Diesel of this period was the "Standard Fuel Oil," designed by C. H. Blanchard and placed on the market in 1913. This was a horizontal single-cylinder two-stroke-cycle air-injection Diesel. The head end of the frame was enlarged to provide space for the scavenging pump; the piston was of the stepped type. The governor controlled both the quantity of fuel and the quantity of injection air to the spray valve. The engine was later redesigned and built vertical, but is no longer manufactured.

Paralleling this development of the air-injection high-compression engine, based on Doctor Diesel's license,



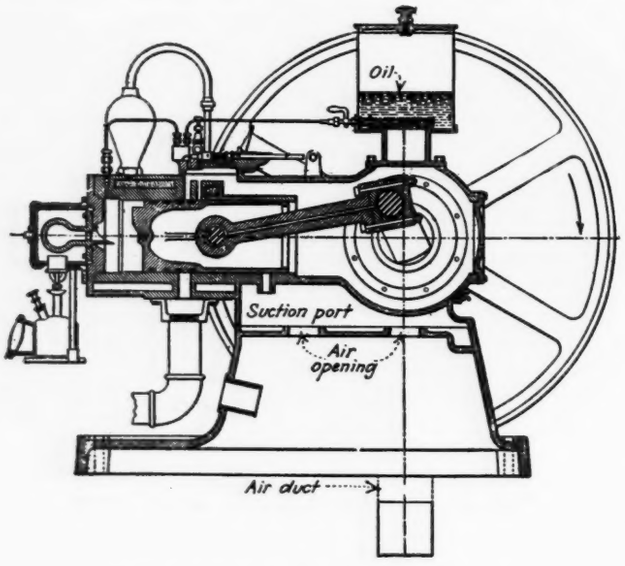
The Franchetti hot-bulb air-injection engine

came the work of the oldest American builder of oil engines, the De La Vergne Machine Company. While the Hornsby-Ackroyd engine, which this firm began building in 1893 under English license, was an engine of the low-compression, 50 lb. per sq.in. hot-bulb type, the De La Vergne Company evolved from it, through a number of gradual steps, a modern type of high-compression, solid-injection, cold-starting engine now known as a "Diesel" engine, yet in which the work of Doctor Diesel had no part whatever.

The Hornsby-Ackroyd engine antedated the Diesel as a self-ignition engine, but Herbert Ackroyd Stuart never received his deserved recognition. Despite its poor fuel economy and its inability to consume heavy

crude oils, it was the first oil engine used for oil pipe-line pumping. Arthur H. Goldingham, of the De La Vergne Machine Company, and the officers of the Standard Oil Company of New Jersey were directly responsible for the first installation, which was made at Farm Grove, Pa., in 1902. By 1908 some 50 of these engines in cylinder sizes up to 27x33 in. had been put in service on various oil pipe-lines. The present widespread use of Diesel engines in pipe-line service is a result of this beginning.

Realizing the desirability of an engine with better fuel economy and particularly one that could use the heavier grades of crude oil, the De La Vergne Machine Company brought out in 1908 a design of the hot-bulb type, but with a higher compression (280 lb.) and air injection. Alexandro Franchetti, now residing in Italy, was the designer, and the engine was known as the Type FH.



The Mietz & Weiss two-stroke-cycle hot-bulb engine

The combination of air atomization and hot-bulb facilitated the clean burning of heavy, asphaltic fuels and permitted the use of a lower compression than with the usual air-injection engine. Maximum pressures were about 450 lb. and excellent fuel economy was obtained.

This type of engine was built in large numbers, but by 1914 the advent of the Price solid-injection system coupled with competitive improvements in high-compression air-injection engines caused it to be abandoned.

Early Hot-Bulb Engines

Side by side with the development of the Diesel industry several American firms were marketing so-called semi-Diesel, or low-compression, oil engines.

The first two-stroke-cycle engine of this type, produced in this country in 1895, was the Mietz & Weiss hot-bulb unit. This engine went through much development and was distinguished in the units built after 1905 by the employment of the cooling jacket as a steam generator. A float maintained a constant water level and the steam was admitted with the scavenging air into the cylinder. The steam was quite successful in maintaining an even cylinder temperature, for the amount of steam generated depended upon the engine load. Hundreds of these engines were sold, but by 1912 the manufacturer gradually found his market disappearing, almost entirely owing to the excessively high price set on the engine, and in 1922 abandoned manufacture.

About 1910 several gas-engine builders took up the two-stroke-cycle semi-Diesel, especially for sale in the oil-well pumping field. The ignition was obtained by several means, including hot bulbs, hot plugs and hot pots. These all used water injection to maintain a uniform cylinder temperature. The designs are satisfactory for many applications and they are still sold to the extent of about 20,000 hp. per year.

Prominent among these builders were Fairbanks, Morse & Co., who in 1913 built their first hot-bulb water-injection two-stroke-cycle semi-Diesel engine, of 20-hp. rating. Quickly, the firm brought out a vertical engine of the dry type, using a separate water-cooled combustion chamber. This was built until 1924, when the combustion chamber was reduced to permit the engine to operate on the precombustion principle and the compression raised to 450 lb. to cause self-ignition.

Since 1912 as many as 78 builders have been engaged in engine manufacture; many of these built only a few units and then turned to other lines. At present there are 49 firms marketing some type of oil engine.

The Hamburg Steam-Diesel Power Plant

By H. Stringer

Deputy Engineer-in-Chief
Shanghai (China) Water Works Company

THE Hamburg Electric Company's plant at Hamburg, Germany, is of special interest due to the fact that it operates steam turbines and a Diesel engine, the latter being used for peak load only. In the building are two 21,000- and one 30,000-kw. turbines, running at 3,000 r.p.m. During my visit the largest unit was down for repair. For peak load there is 15,000-b. hp., nine-cylinder, air-injection Diesel. This runs about four hours daily. The oil consumption was reported to be 0.33 lb. per 1 hp.-hr. Although the cylinders are 28-in. bore by 59-in. stroke, the unit has given no trouble.

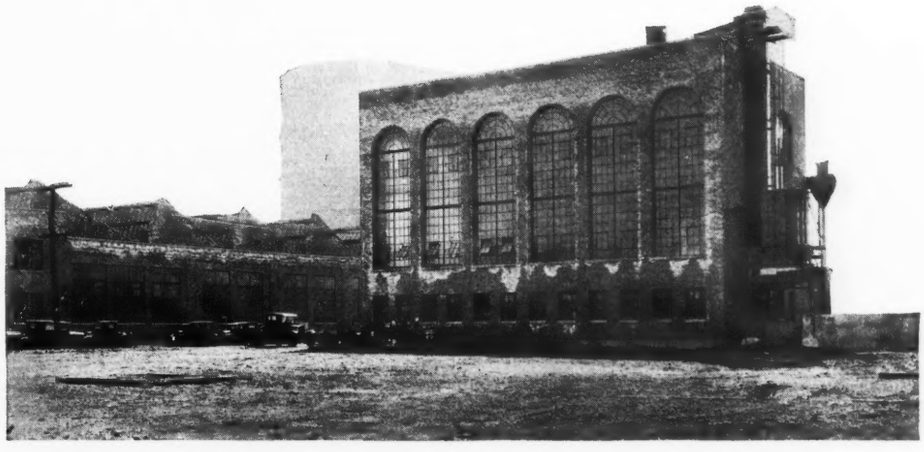
The boiler room contains ten boilers. Eight 86,000-sq.ft. units are fitted with chain-grate stokers and have automatic coal feed from the headers. The other two, of 107,000 sq.ft., use pulverized coal. Steam is supplied at 440 lb. and 200 deg. superheat. It is claimed that the boiler efficiency reaches 81 per cent with 10 per cent CO_2.

Local opinion differs as to the advantages of pulverized coal, the chief argument being that a cheaper native coal can be used, thereby insuring against shortage due to mine strikes. The fuel now burned is half english, of 13,800 B.t.u., and half German, of 13,500 B.t.u. per pound. The English coal is the cheaper of the two.

The entire boiler equipment is managed from a central control room, where recorders show the operation of all the units. Ash disposal is by the sluicing method; the channel is tile lined and has a grade of 1.5 per cent. The ashes are carried to a settling tank, from which point they are received by a grab bucket. The pumps are of the centrifugal type and, as the water is alkaline, have a life of about eight years. The steam main, which is in duplicate, is only 12 in. in diameter, somewhat unusual for so great a steam flow.

UNIT HEATERS

Lower First Cost in Industrial Type Building



An initial saving of $25,000 made in heating system of the new cab shop at the Otis Elevator Company's Harrison Works

TO HANDLE a growing elevator cab business the Otis Elevator Company found it necessary to increase its manufacturing facilities, and during the summer of 1928 built a new cab shop at its plant on the Passaic River, Harrison, N. J. The new building, of brick and steel, is 447 ft. long and 238 ft. wide, and adjoins a somewhat similar building erected a few years ago. As seen from the photograph, the roof is of the saw-tooth construction common to manufacturing buildings of this type, and it forms six bays. The last bay to the right is separated from the rest of the building by a brick wall. It houses lacquering equipment. Across the rear is a loading platform. The front portion, also partitioned off from the rest of the building, houses Parkerizing and plating equipment, leaving a manufacturing floor space of about 51,080 square feet.

By using 50 lb. pressure and unit heaters instead of 5 lb. pressure and direct radiation, a saving estimated at about $25,000 was made in the first cost of the heating system. This saving is not unreasonable when it is considered that by using the higher pressure it was possible to reduce the size of the steam header from 14 in. to 8 in. without increasing the velocity of the steam. The same reduction in pipe size was possible for the main branches from the header. As all the piping is supported from the roof steel, the reduction in pipe size greatly reduced the load on the roof, and consequently it could be of lighter construction.

The unit heaters contain integral cast aluminum-silicon alloy heating elements of streamline design, which reduces the air friction through it. These units are suspended from the roof steel about 30 ft. above the floor, as indicated in Fig. 1. Traveling-crane construction and the desire to use all the manufacturing floor space made this unusually high location necessary.

Two sizes of units have been used. The smaller unit circulates 3,000 c.f.m. of air and delivers about 188,000 B.t.u. per hour; the larger unit circulates 6,500 c.f.m. and delivers about 395,000 B.t.u. In both sizes the air is heated from about 60 deg. to 118 deg. and delivered at a velocity of 1,200 ft. a minute.

Twenty-seven of the smaller units are used to heat the manufacturing space and shipping bay, while four of the larger units and three smaller ones are used to heat the two rooms at the front of the building.

As will be seen from Fig. 2, the manufacturing area is protected from heat losses by the partitioned-off space, in the front, the lacquer room and old building on the sides, the back and roof being the only exposed surfaces. This has largely influenced the location of the heaters.

The problem of heating with unit heaters is one of air circulation. With the type of heater installed, a relatively large volume of tempered air is used to produce the circulation desired. Generally, these units are located so that they deliver air at an angle to the sides of the building and thus set up a general circular movement of air around the perimeter of the building.

The protected nature of the manufacturing space made this plan of circulation undesirable. Instead, the units have been placed so as to produce four separate circular movements of air—three in the manufacturing space and one in the shipping bay. In planning this air movement no attention was paid to the roof construction and location of skylight windows. The circulation produced by

this heater arrangement has been found entirely satisfactory. It heats the large space without hot or cold pockets, except when it is interfered with by the opening of a larger door in the front of the building. Obviously, it is impossible to obtain uniform heating when this is left open. However, the installation of an additional unit

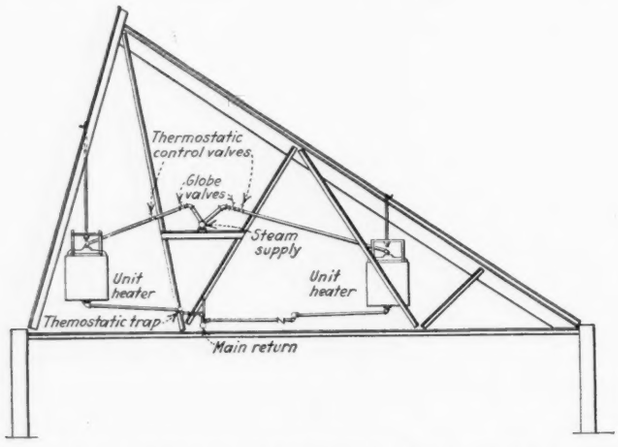


Fig. 1—Detail of unit heater support and piping

in front of this door is contemplated in order to offset its effect as much as possible.

Heating of the lacquer room involved some special considerations. Unit heaters for this room did not seem practicable. It was felt that the air movement they produced would stir up enough dust to affect the lacquering process. Conseqently, cast-iron radiators, using steam at five pounds pressure, were installed along the exposed wall and under the skylight windows in a horizontal position. In addition to the cast-iron radiation, seven heater stacks were installed in front of air intake openings. Each stack is made up of 29-in. units, five units wide and two units deep, each unit containing one row of tubing 2 ft. 6 in. long.

At first glance it would appear that an excessive amount of radiation had been provided for the room. However, the large amount of ventilation necessary to remove the lacquer fumes greatly increases the heating load.

The room contains sixteen lacquering booths, each of which is connected to a venturi-shaped stack, which exhausts about 100 c.f.m. of air for each square foot of booth opening, or about 8,000 c.f.m. per booth.

The fans for the venturi-shaped stacks, as shown in Fig. 2, are in a room partitioned off from the lacquer bay. This design permitted using open-type motors, which, because of the danger of fire from lacquer fumes, would have been impossible had they been located in the lacquer room. These fans, one for each booth, take air from outside and deliver it to the throat of the venturi-shaped stack. Thus the air handled by the fan does not have to be heated and the fans do not come in contact with the lacquer-laden air exhausted from the booths.

Cast-iron radiators, heater stacks and unit heaters are all equipped with thermostatic traps. Condensate from the unit heaters and drips from the high-pressure mains are delivered through high-duty traps to a vacuum return main, as is also the condensate from the low-pressure system. A duplex vacuum return and low-pressure boiler-feed pump capable of discharging the returns from 100,000 sq.ft. of equivalent radiation at a pressure of 30 lb. deliver the condensate from the new building and the adjoining plant to an open-feed water heater in the boiler house.

Thermostatic air-operated valves regulate the steam supply to both the unit heaters and the low-pressure radiators. The thermostats are placed five feet above the floor at points indicated in Fig. 2, and are adjusted to maintain a temperature of 65 deg. during the working day. Other thermostats, marked *N*, control the regulating valves during the night and are set to turn the steam on when the temperature falls below 40 deg.

The heating requirements of this new plant, together with the steam needed for the Parkerizing process, made additional boiler capacity necessary.

It was decided to build a new plant instead of making additions to the old boiler house, which had served as a central heating plant for the buildings that comprise the Harrison works and, having about reached the end of its usefulness, could no longer be operated economically.

The new plant is on the bank of the river, where coal can be delivered by barge direct to a storage yard, which is served by a drag scraper. The coal is reclaimed from storage and delivered by a bucket elevator to a steel bunker above and in front of two 5,180-sq.ft. water-tube cross-drum boilers. It falls by gravity from the bunkers

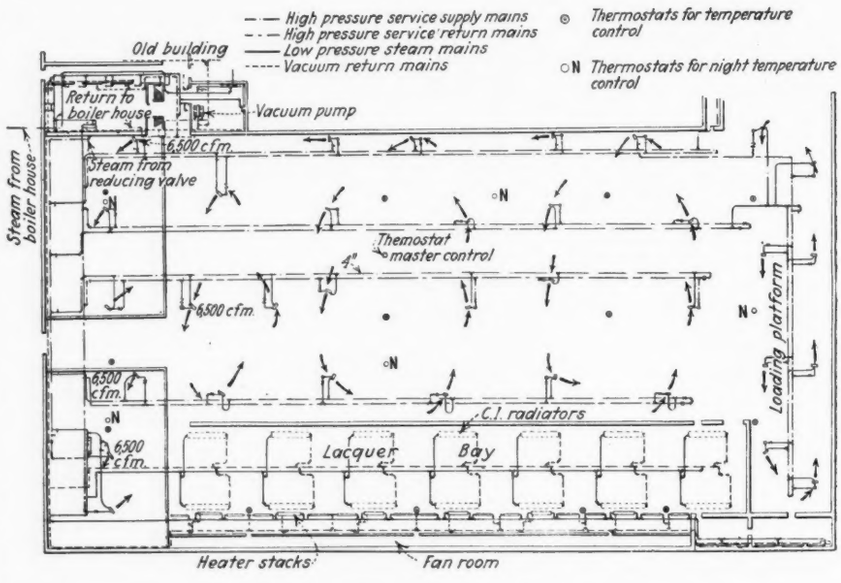


Fig. 2—Plan of new building showing arrangement and location of unit heaters

to two 4,000-lb. and one 2,000-lb. unit pulverizer mills.

The two larger mills are motor driven and each serves one boiler. The smaller unit is arranged for both motor and turbine drive and serves either of the two boilers. It is intended for use during light loads at night and in the spring and fall. One boiler operating at 175 per cent rating will furnish all the steam required for present peak-load conditions, thus allowing the other unit to be used as a spare.

An interesting feature of the plant is the short Prat

steel stack, the top of which is only 29 ft. above the breeching of the boiler house. Draft is induced by a motor-driven fan that delivers a portion of the flue gas into the throat of the venturi.

Space has been left for the installation of a small oil-fired boiler, which will be operated during the summer to supply steam to the Parkerizing process. During peak loads this process requires about 2,500 lb. of steam an hour. This small boiler has been found desirable because of the difficulty experienced in operating the larger units at very low rating.

Although the boilers were designed for 100 lb. pressure, it was found possible to lower the pressure to 65 lb. The steam is delivered underground to the new building

Fig. 3—View of manufacturing space looking toward loading platform

through a 6-in. main. A 4-in. branch supplies steam to the adjoining building, while the steam to the new building passes through a reducing valve, which lowers the pressure to 50 lb., at which pressure it is used in the unit heaters for heating the main part of the building and in the Parkerizing process. Two other reducing valves one 3 in. in diameter and the other 1 in. lower the 50 lb. steam to 5 lb. for use in the wall-type cast-iron radiators and the heater stacks.

Information for this article was obtained through the courtesy of W. O. Moyer, building engineer, the Otis Elevator Company; J. R. Cooper, of the Thermal Unit Company, and C. F. Mau, Warren Webster & Company.

An Electric Arc Can Cause Serious Injury

By Marin Phillips

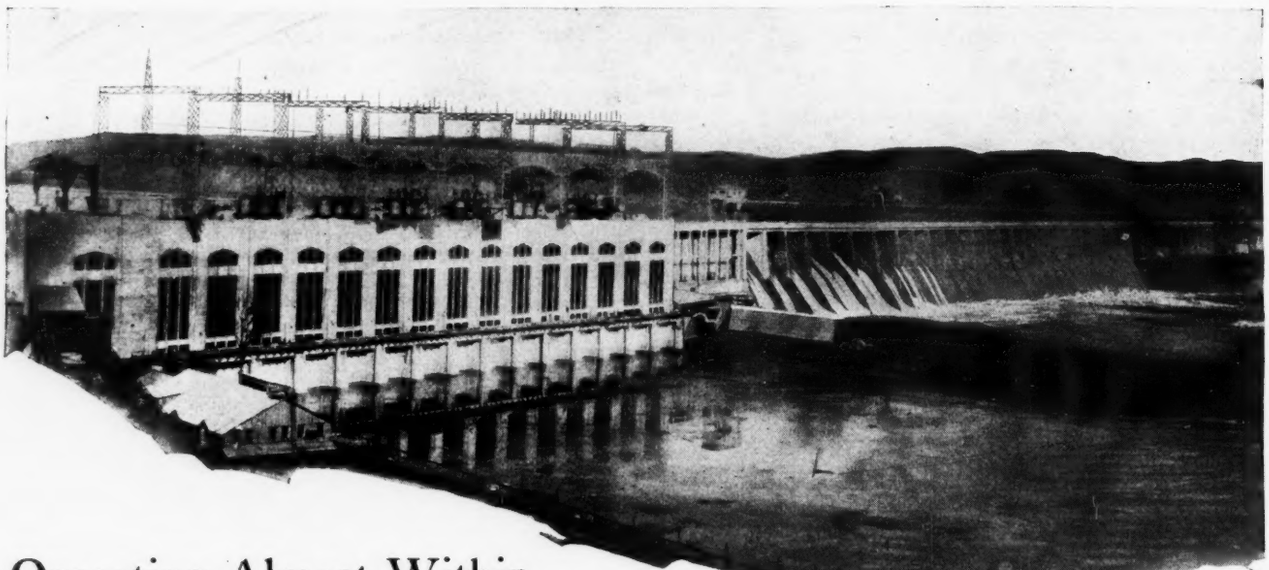
A SHORT circuit cleared itself by burning free. This fault occurred in a duct as a result of water leaking in during a rainstorm. The circuit was a three-phase feeder line from a bank of transformers outside of a building to the switchboard inside, and it consisted of two 2,000,000-circ.mil cables in parallel for each phase, or six conductors in all. These cables were carried in a duct down the transformer base through the foundation of the building to the switchboard, which was in the basement. The entrance to the duct had been sealed with an insulating compound, but this had cracked and allowed water to leak in, causing the insulation of the cables to rot. Finally, a short circuit developed.

There were three power stations feeding into this short circuit. After the fireworks and smoke had cleared, the six cables were found to be melted and burned away for a distance of about five feet, as if they had been lengths of fuse wire. This is an illustration of the heat generated in a heavy short circuit and should impress upon those who work around live switches and busbars the necessity of working safely. This incident shows the slim chance a workman or a group of workmen has to escape serious burns if caught in the zone of a short circuit. The occurrence also emphasizes the necessity of installing circuit breakers equipped with overload relays and automatic tripping devices as a safety measure.

When work is to be done on live circuits in close quarters, all grounded metal frames, piping and steelwork of the building should be covered and protected with rubber blankets if there is the least possibility that the workman can touch the grounded parts when in contact with the circuit. For protection against low voltage, rubber blankets can be made out of ordinary rubber sheet packing, of which most plants usually have a supply on hand. When working overhead on live circuits suitable platforms should be erected for the workmen to stand on. If this cannot be done, they should use linemen's belts or ropes securely fastened about their bodies and to some objects strong enough to support their weight. This is a precaution to take for the workmen's safety so they cannot fall if they get a shock or flash. Under these circumstances they will try to jump free from the hazard.

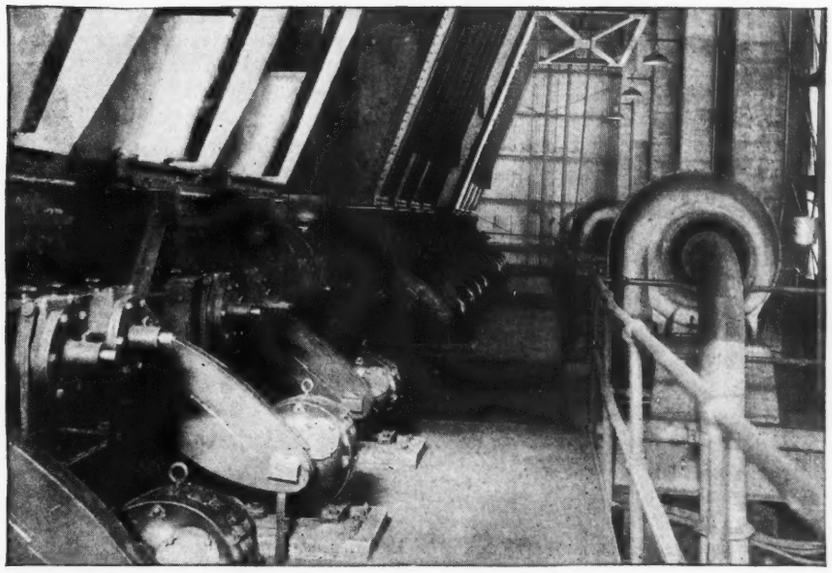
When a platform is rigged up to work on, it should be protected with hand railings around the side, so that the workmen cannot walk off or fall in case of a shock or flash. When working on live circuits it is advisable not to use too many men, especially if they are to work in a close place, for unneeded men on the job only increase the number injured in case the unexpected happens. In one instance thirteen workmen were burned to death in an accident the cause of which was given as the explosion of a defective instrument transformer that had just been placed in service. The flash and oil started a fire that trapped the men in a small switchhouse and prevented their escape. This incident will bear out the statement that it is a good safety precaution to have as few men as possible around such dangerous places at one time. The accident also shows the necessity of installing as much of the high-voltage equipment out in the open as possible.

Whenever it is absolutely necessary to install electrical equipment in close quarters enough doors should be provided so that there cannot be any possibility of trapping workmen in the building in case of a serious blowup in any of the equipment. In industrial plants, in most cases, one or two first-class workmen with reliable helpers will be found sufficient to do the work on live circuits. As a further precaution, wherever it is possible to do so, an extra man can be placed at the circuit breaker and instructed not to take his eyes off the men doing the work. This man should be further instructed to trip the circuit breaker at once should he notice the workmen getting a shock or flash. It would also be well for this extra man to know how to apply artificial respiration, so that he could act at once in case of an accident. No workmen except those who have had several years' experience and are known to be in the habit of working safely should be allowed to work on live circuits.



Operating Almost Within Sight of Each Other

At Havre de Grace, Maryland, a few miles below the huge Conowingo power development (above) is an old mill (below) built in 1790 and operated regularly by W. W. Wilkinson, the present lessee. Although the original wooden overshot wheel has been replaced by a 32-ft. steel wheel, the old stone burrs, which it drives through gears, are still in use.



Each group of two screw feeders is driven by a 2½-hp. 230-volt direct-current motor.

Automatic Combustion Control *Improves Boiler Operation*

By M. W. Horley

Boiler-Room Engineer
Pennsylvania Water & Power Company

Without the Use of Preheaters or Economizers *an average of 78 per cent boiler and furnace efficiency is maintained at an average of 250 per cent boiler rating when burning a combination of pulverized and anthracite river coal.*

In the Pennsylvania Water & Power Company's steam plant, at Holtwood, Pa., the boilers are of the cross-drum type. They are thirty tubes wide by eighteen tubes high and are baffled for three passes. The front and side walls are air cooled, whereas the rear wall is refractory water cooled. In addition there is a horizontal water screen above the ashpit, giving each boiler a total heating surface of 14,834 sq.ft. Each boiler is equipped with convection type superheaters at the top of the first and second passes directly under the steaming tubes. The boilers are fired with pulverized coal, either 100 per cent river bottom anthracite or 100 per cent bituminous or a mixture of anthracite and bituminous in any proportion needed.

There are four groups of pulverized-coal feeders to a boiler. Each group has two screw feeders, either of which can be taken out of service by a friction-clutch mechanism. The feeders are directly under a 70-ton bunker and are fed by gravity. Each group of feeders is silent-chain-driven by a 2½-hp. adjustable-speed 230-volt shunt-wound direct-current totally inclosed ball-bearing motor, as shown at the top of this page. The pulverized coal feeds through right-angle fantail-type burners, of which there are eight per boiler, Fig. 1.

Primary air is supplied to the burners by a 1,700-cu.ft. per min. fan driven by a 40-hp three-phase 440-volt variable-speed induction motor. Secondary air for combustion is admitted through a set of spring-loaded doors near the rear wall on each side of the furnace. There are nine doors on each side, each door opening directly into an air passage in the side wall, the air going thence to the hollow front wall, where it passes into the furnace through 68 checkered air ports.

Induced draft is supplied by two multivane fans per boiler, each having a capacity of 70,500 cu.ft. per min. at 640 deg. F. These fans are driven by 75-hp. variable-speed 440-volt wound-rotor motors, Fig. 2. The mechanical control for the induced-draft fans is on the same elevation as the motors. Power for these fans is supplied from the 440-volt switchboard, Fig. 3, on the operating floor of the boiler room.

Each boiler is equipped with recording and indicating meters, Fig. 4. The boiler meter records the steam flow, air flow, boiler rating, flue-gas temperature and draft and it integrates the amount of steam generated. The indicating meters show the firebox draft, uptake draft and primary air pressure. In addition to these meters there is a graphic CO_2 meter connected to each boiler. In the last pass of each boiler there is

a device for detecting by eye the density of the smoke passing to the atmosphere. It is visible from the operating floor.

Automatic combustion control has been installed for the purpose of regulating the fuel feed in relation to the load demands and for maintaining predetermined combustion conditions. The load on the station is variable, ranging from approximately 5,000 to 28,000 kw., with an average of approximately 24,000 and a normal boiler rating of approximately 250 per cent. The control is set to allow steam-pressure fluctuations within four pounds above or below normal.

The coal burned is different from that used in most plants. The anthracite is dredged from the Susquehanna River and contains a certain amount of foreign matter such as sand, stone and pyrites, and averages about 12,000 B.t.u. dried. The bituminous coal, while superior to the river-bottom anthracite, is not so good as the coal usually fired on stokers. It is not necessarily superior to the anthracite, but the presence of more volatile matter is desirable to obtain prompt ignition. Bituminous is used only when anthracite cannot be secured in sufficient quantity. The present mills will not handle the required amount of anthracite for steady full-plant load. The general practice has been to mix the two coals in the proportion of about 50 per cent anthracite and 50 per cent bituminous, depending upon load and other conditions.

Manual adjustments necessary for good operation of the control are reduced to a minimum. About the only adjustment that has to be made is the amount of excess air carried by each furnace. The adjustment is made in the rear of the boiler meter on a floating mercury bell. Periodic readings are taken with a portable Orsat in order to check this adjustment, and it has been found by actual practice that this setting requires very little attention unless the type of coal used in the furnaces is changed, needing only a readjustment of secondary air distribution and primary air pressure. Under normal load swings the master control has satisfactorily handled the plant for approximately 3½ years. Abnormal load swings—that is, load disturbances—sometimes require attention manually by dropping boiler or feeders. Provision is made for full or partly automatic control, and for hand operation.

Practice has shown that to burn river-bottom anthracite a lower percentage of excess air is required than when burning bituminous coal. The furnace must be kept sufficiently hot to ignite the coal immediately after it leaves the burners. In order to keep the furnace setting at the right temperature an adjustment for excess air is made to the side-wall dampers.

River coal being heavier than bituminous, it falls more readily into the furnace through the burners. This calls for less primary air at the burner exits. The primary air for burning anthracite is also used to create a greater turbulency. It has been found that by the aid of diffusers the air mixes more easily with this type of coal than it would if the coal were allowed to pass through the burners with just the velocity created by the primary air.

This station was originally designed to burn 100 per

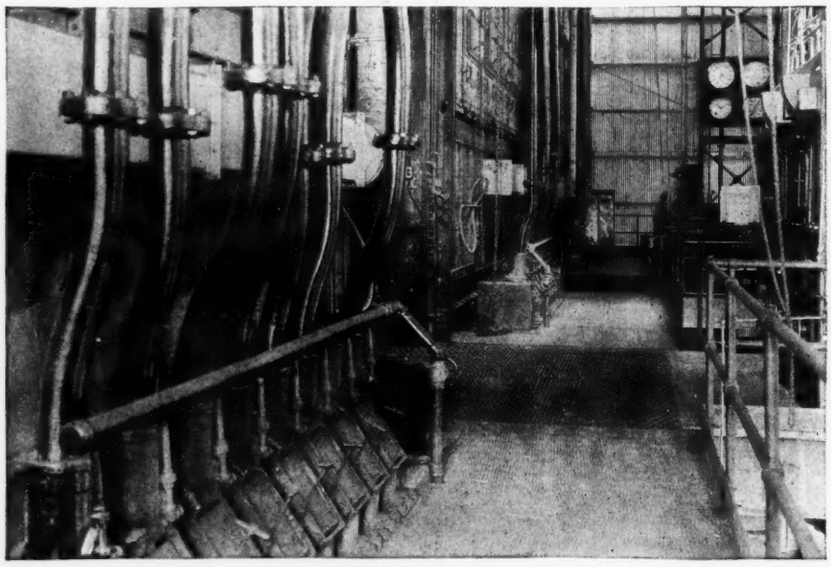


Fig. 1 (Above) — The pulverized coal feeds through right-angle fantail burners, of which there are eight per boiler. The boiler control panels are against the wall on the extreme right

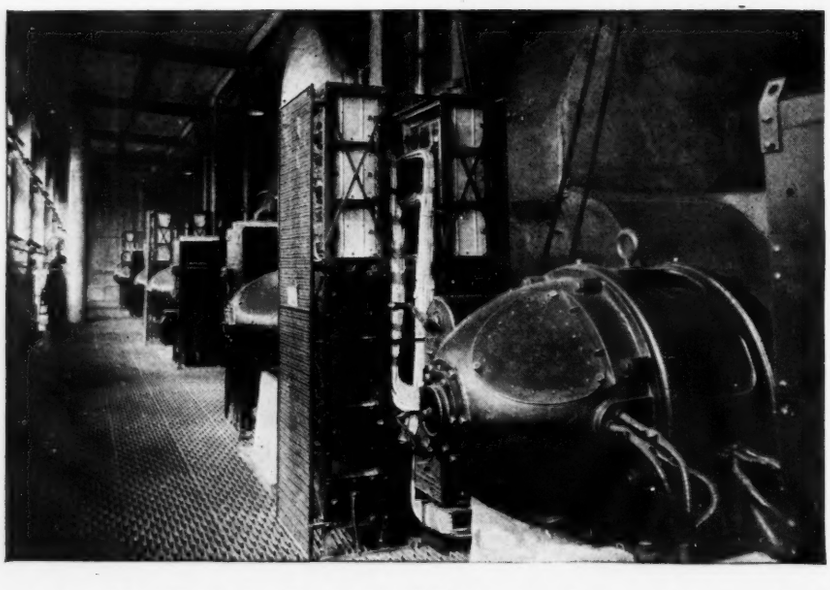


Fig. 2 (Left)—Induced draft is supplied by two multivane fans per boiler, each having a capacity of 70,500 cu.ft. of gas per minute at 640 deg. F. These fans are driven by 75-hp. variable-speed 440-volt wound-rotor motors

cent river coal, but owing to the shortage of this fuel it can be used only when the station operates on a decreased load.

Bituminous coal, owing to its high volatile content, burns, in suspension, more easily than river coal and

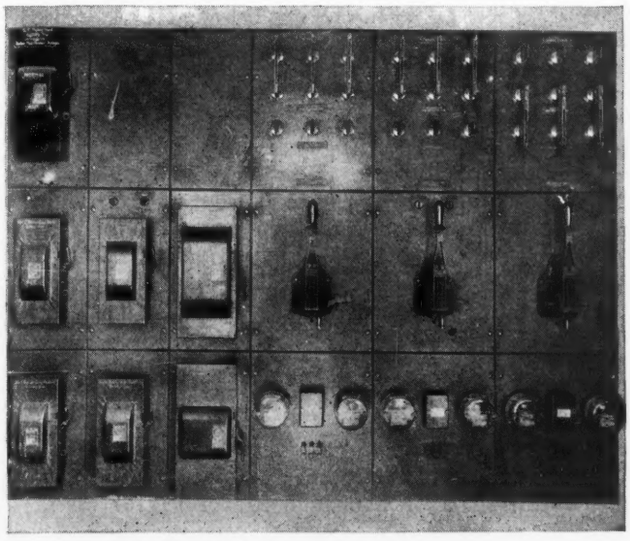


Fig. 3—Switchboard, located on the boiler-room floor, from which power is supplied to the induced-draft fan motors

therefore requires a lower-temperature furnace setting near the burner exit. An adjustment is made so that more air is allowed to enter through the top doors than through the lower doors of the furnace. Bituminous coal requires more primary air than anthracite. Being lighter, it has to be fed into the furnace at a higher velocity.

The proportion of 50 per cent anthracite and 50 per cent bituminous has been found to be the best combination in this station, for the reason that the mills can supply the demand. The burning of this mixture requires adjustments in the supply of secondary and primary air, best results having been obtained by striking a mean average from those obtained when burning the two coals separately. A small change in the mixture, up to 10 per cent, does not require resetting the side wall doors or the primary air supply. This proportion of the two fuels is carried throughout the year at Holtwood and has been found to burn satisfactorily at about 28 per cent excess air.

A card-index system is used on which is recorded the dates of inspection and repairs made to the automatic control. This system has been found to be useful in keeping a check on the operation of the different meters. It has been found by actual practice that the automatic control will work under any normal conditions if the mechanism is kept in good condition.

Every four months each boiler meter is removed from service and thoroughly overhauled. The gears and cams are carefully checked to see that they are held tightly on the shafts by the setscrews and pins. If loose or out of place, they are tightened and restored to their normal position. All old oil is cleaned out of the mechanical box and replaced by new. After a meter has been put in condition it is calibrated, all pens being placed on zero for this operation.

The same inspection applies to the induced draft fan control. In this control there are several small gears that require careful attention. The clutches of this control are taken out and all springs and small gears are checked to see that they are not worn excessively. If they are too worn for good service, new parts are installed.

The motor is cleaned and lubricated and placed in first-class condition. Old oil is cleaned out of the control box and replaced with clean. The master control has been found to require more careful checking than other parts of the automatic system.

The springs that act as kick-backs for the contactors need attention, as they are likely to become weak from long usage. This also applies to the springs that return the step wedges to normal position. These springs, while they do not readily become weak from long use, require adjusting and straightening. The contact points need dressing up with a piece of fine sandpaper.

The relay contact points in this meter require the most care of any electrical part of the apparatus. It is necessary to take them out and finish the faces of the points about every four months. These points send the electrical impulses to the entire system, and therefore they have to stand more usage than the others. It is necessary to replace these contacts with new ones about every three years.

The automatic control has an advantage over hand-operation methods because it checks the slightest rise or drop in the steam pressure by supplying the necessary amount of air and fuel. Hand-operation methods at their best, no matter how intelligent and conscientious the operator was, were less efficient than automatic control.

Combustion of the variable mixtures used would require considerable attention if fired by hand-operation

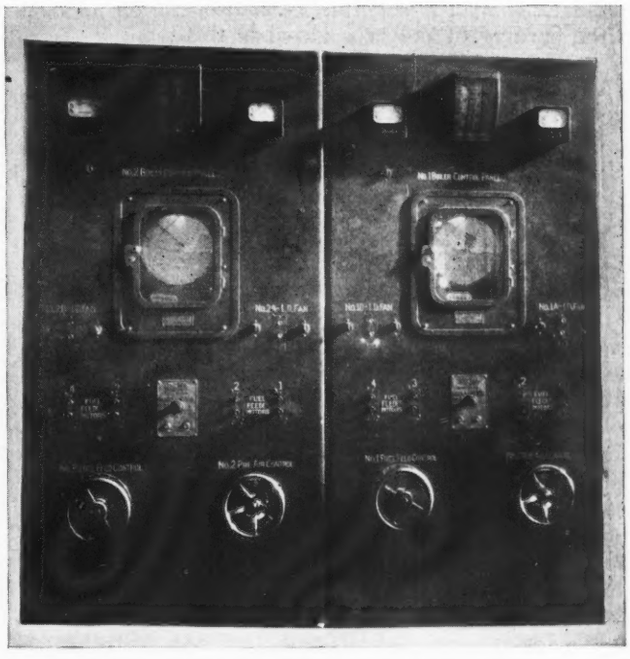


Fig. 4—Two of the boiler control panels, one for each of two boilers

methods, but it has been found that the automatic control functions well under such conditions. But little trouble has been experienced through failure of the control to make the boilers carry whatever load is demanded.

An operator cannot tell at a glance just what amount of fuel and air is required to bring the steam pressure back to normal, and as a result he is likely to give it an excessive amount at times. The master control has proved by operation that it can maintain efficient combustion under the conditions called for in every-day practice.

The average yearly boiler efficiency is approximately 78 per cent, with an average boiler rating of 250 per cent. This efficiency, when it is taken into consideration that no economizers or air preheaters are used, proves beyond doubt that automatic control is more to be desired than hand operation.

Effect on Boiler Labor

The installation of automatic control tends to reduce the cost of maintenance on the boilers and furnaces. This is accounted for by the steady rate at which fuel and air are fed to the furnace. The rate of feed is such that the excessive temperatures usually encountered in a hand-operated furnace are generally kept in check by the steady operation of the control.

It has been found that, when firing pulverized fuel, with hand operation there is a tendency on the part of the operator not to adjust the amount of air required for best efficiency. If this procedure is not carefully checked, the side walls and front walls, owing to the increased temperature, will start spalling.

Too much fuel will cause unburned coal to be deposited on the lower bank of tubes in the first pass of the boiler. If this is allowed to accumulate the tubes eventually will become slagged over, as a result of the fusing of the deposit. When this happens it is usually quite a job for the maintenance crew to open up these passes. For these reasons, I feel safe in saying that automatic control is superior to hand-operation methods in the burning of pulverized coal in this plant.

Engineer-Lawyers—A Combination With Latent Possibilities

A True Story

ONE summer evening three or four years ago as a Mississippi River excursion steamboat, with a load of negro excursionists aboard, was landing at St. Louis, a man fell overboard and was drowned. But few of the many hundreds of passengers knew of the accident at the time, and even the man's wife was not aware of the identity of the drowned one until he had failed to come to her after all had disembarked. Later, when demand was made for compensation, the steamboat company denied liability, whereupon suit was promptly entered.

Some months later an engineer of mature years was summoned as a petit juror in the United States District Court and drawn to serve on this case. The plaintiff's attorney had a goodly number of witnesses, and it was soon evident from the testimony offered that the endeavor was to show negligence in landing and that the jar, due to bumping into the wharf, was responsible for the tragedy.

The evidence of the defendant, on the other hand, was intended to show that all the safeguards against accident required by law, and even more, had been provided, that the landing had been effected in the usual proper manner and that the party could not have been precipitated over any of the railings unless he had been guilty of contributory negligence. It was quite apparent to our engineer juror that the answer hinged on the consideration of a few principles of mechanics.

After the closing arguments, charge by the judge, and the other usual court formalities, the case was given to the jury, which retired in the customary manner. A vote was at once taken, resulting in seven votes for the plaintiff and five for the defendant, a majority in favor of awarding damages. Each juror was given opportunity to discuss the merits of the evidence, which most of them did. Apparently, none had had any scientific training to any extent. Mr. Engineer juror spoke last, outlining in simple terms the effect on one's balance of a very slight disturbance of his equilibrium, the restraining influence of a bar at or above the center of gravity of one's body, the damage that must inevitably result from unusual impact of boat on dock, etc. The plaintiff had no children, was a young woman entirely capable of self-support, so that there was no cause for sentimentality, although some of the jurors were inclined to award damages just because they thought the company ought to pay something, as though law and justice to both parties were not the real factors at issue.

Immediately after the engineer juror's statement, another vote resulted in a unanimous verdict for the defendant. In short, the engineer won the defendant lawyer's case for him, although the latter never knew it.

If this attorney had had any perception of the very simple scientific principles involved and could himself have brought out the really controlling features by appropriate questioning of the witnesses, or had he invoked the services of an expert witness or two, he could easily have won the case himself.

Every engineer who has had any experience in court cases involving engineering or scientific principles in some form has heard absurd questions asked and seen verdicts reached quite at variance with what should have been the proper conclusion.

Is there not, then, a fine opportunity for those who combine a good engineering education with a complete legal training, to fill a more or less unrecognized place in the social structure? There have been such, but their number has been small.

Here in the midst of two crowded professional fields lies an uncultivated plot, rich in the possibilities for profitable service. To young men with a flare for scientific knowledge or who delight in winning or in making others look at problems in their way, this suggestion should luringly appeal. Two, three or four years additional spent in acquiring thoroughly both branches of learning will, in the long run, be generously repaid. But to older men, say of 35 or 40, with some practical experience and knowledge of human nature and ways of the world, this may also appeal, even though the legal knowledge be acquired less intensively by night courses instead of by the regular daytime procedure.

That there are such biprofessional men available for cases at law will quickly become known and a growing clientele, paying fees commensurate with the special services rendered, will soon result.

Briefly, the opportunity to cultivate a fallow field, the need for which is perhaps not yet fully recognized, but which nevertheless exists, is waiting for able cultivators.

Owing to the presence of scientific principles vital to practically every field of present-day activity, the possibilities of this suggestion are far greater than is at present realized by laymen, lawyers or engineers.

BLEEDER TURBINES

Should Be Custom Built

By M. D. Church
President Moore Steam Turbine Corporation

To get the best efficiency and greatest usefulness from bleeder turbines they should be designed to meet the process requirements peculiar to each installation. Some of the many bleeder-turbine arrangements are discussed.

TO MEET the variety of requirements for power and for exhaust steam in many different industrial and power plants, bleeder turbines must be arranged in many different ways. Few users realize the possibilities, and turbine builders are frequently more interested in adhering to a "standard" frame than in satisfying requirements with a unit that will give greatest economy under actual conditions.

Bleeder turbines may be classified in several ways. First, they may be condensing or non-condensing. Non-condensing bleeder turbines are highly economical when the demand for steam at bleeding pressure plus the demand for exhaust steam at a lower pressure is steady enough and large enough to insure little or no waste of steam to the atmosphere. The initial cost is also low, as there is no condensing equipment to install.

Condensing bleeder turbines are far more common. Steam is bled for process or heating work as required, and any surplus is efficiently used down to condenser pressure in the low-pressure end of the turbine, producing more power per pound of steam than would be possible in a non-condensing turbine.

In many cases it pays to reduce the vacuum in the condenser by using a smaller quantity of circulating water in order that the resulting warmer water will more nearly meet industrial requirements. Sometimes the same circulating water can be used in two or more condensers in series and thus reduce loss of heat from the plant.

Methods of control of bleeder turbines create a second classification. The simplest bleeder turbine may be called the "hole-in-the-casing" type. A connection for withdrawing steam is provided at a chosen stage or at several stages, but no means for maintaining stage pressure is provided. With this type of turbine the pressure within the casing at the stage or stages from which steam is to be withdrawn varies greatly with load and with quantity of steam withdrawn. For some services this construction is suitable, but for most industrial purposes it is wholly unsuited, as the pressure and quantity of steam available for bleeding are too variable.

For most industrial purposes we require a supply of steam at practically constant pressure available in the quantity desired and, so far as possible, independent of turbine load-variation within the normal range. This necessitates the use of a turbine with automatically controlled bleeder pressure. A turbine of this type is shown in cross-section in Fig. I. Steam under control of the constant-speed governor is admitted to the first stage of the turbine and passes through one or several stages, depending on the difference between initial steam pres-

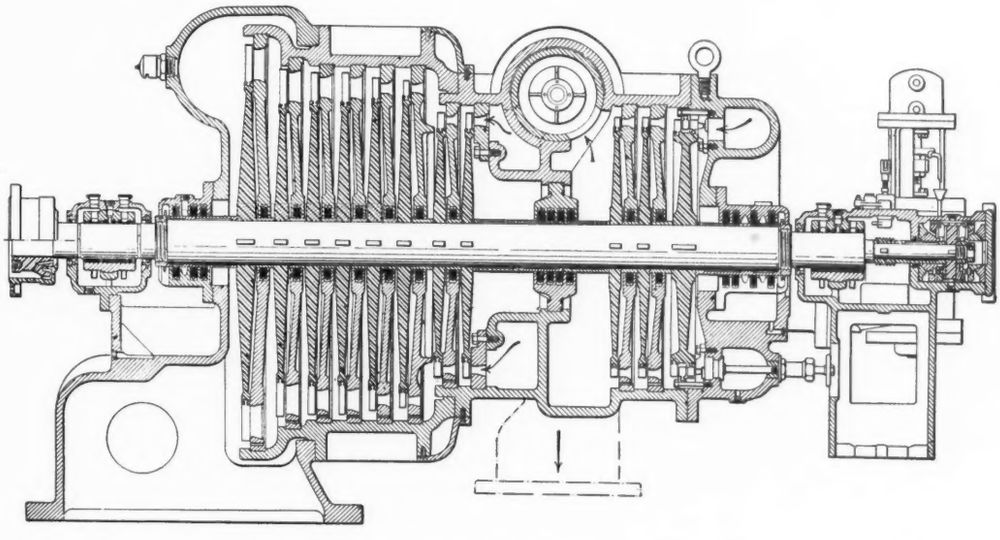


Fig. 1—Cross-section of a bleeder turbine with constant pressure control

sure and bleeding pressure. At the proper stage a pipe connection to the casing allows steam to be withdrawn. Surplus steam passes through the bleeder control valves on its way to the succeeding stages. These bleeder control valves are shown in detail in Fig. 2, together with the automatic device for actuating them. Should steam

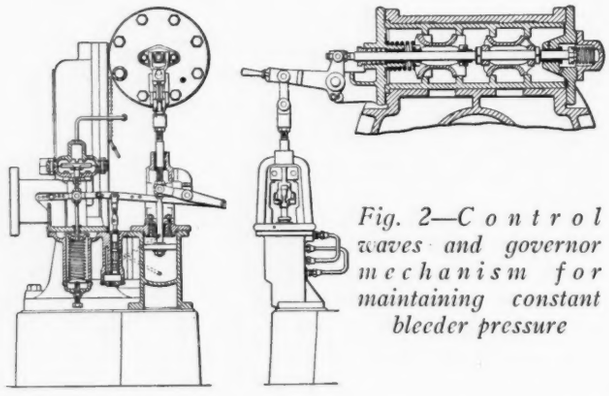


Fig. 2—Control valves and governor mechanism for maintaining constant bleeder pressure

pressure at the bleeder stage be too low, the control device will close the bleeder valves, restricting the flow of steam to the condenser until pressure is built up to normal. If pressure increases, the valves are opened to allow more steam to pass through the condenser. In practice, bleeder pressure is closely maintained, provided, of course, there is load enough on the turbine to require sufficient steam to meet demands.

When it is expected that the turbine will at times be called upon to bleed as much steam as possible, it is important that the type of bleeder valve be such that it will not leak when closed. At such times leakage in excess of the small amount necessary to prevent overheating of the low-pressure blading represents direct waste. Fig. 3 is a chart showing the performance of a bleeder turbine.

A turbine may be bled at more than one point when steam is required at different pressures. In this case the

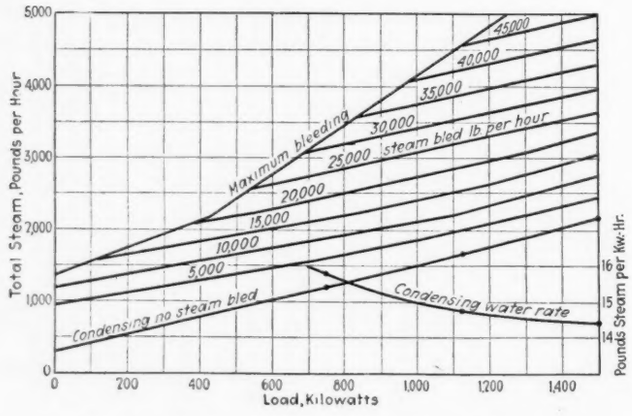


Fig. 3—Typical steam-consumption curves for bleeder turbine

bleeder control mechanism becomes somewhat more complex, but the principle remains the same.

Mixed-pressure bleeder turbines are similar to bleeder turbines, but allow any available excess of low-pressure steam to flow into the turbine and do work, as well as bleeding steam when pressure in the low-pressure line tends to drop. Fig. 4 is a typical performance curve of this type. A constant-speed governor is arranged to actuate the bleeder valve when necessary to limit the admission of low-pressure steam. Turbines of this kind are useful to balance conditions in plants where there is sometimes an excess and sometimes a deficiency of low-pressure steam.

Non-condensing bleeder turbines may be so arranged as to bleed at one fixed pressure and also to maintain exhaust pressure constant. When so controlled the power produced depends upon the amount of steam passed, so the turbine must drive a machine that can absorb the variable amount of power produced. This is generally best accomplished by using the turbine to drive an alternator operated in parallel with other alternators, and supply to the system the variable amount of electric power that is produced as a byproduct of the drop in steam pressure in the turbine.

The "inverted bleeder" turbine serves still another purpose. As an example of its application, consider a

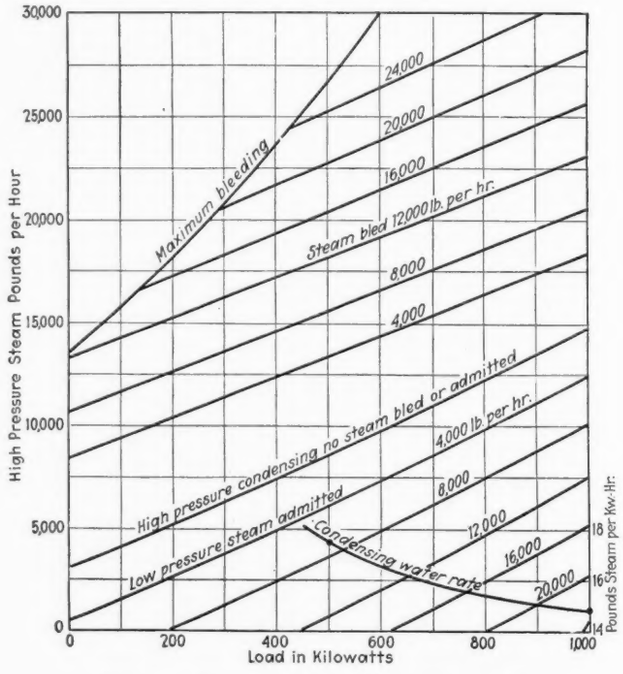


Fig. 4—Steam-consumption curves for mixed-pressure turbines

plant that has a battery of boilers in good condition generating steam at 150 lb. for general use in the plant. Process steam is used at 20 lb. New boilers for 350 lb. pressure are added. To produce power by the pressure drop to 150 lb. and to 20 lb., an inverted bleeder turbine may be used. This is a regular bleeder turbine designed to bleed at 150 lb. and exhaust at 20 lb. The bleeder valve and its controlling mechanism, however, are arranged so that the bleeder valves will pass just enough steam to supply the demand for exhaust steam and maintain 20 lb. pressure at the turbine exhaust opening. Any excess not required at 20 lb. is thus forced out of the bleeder opening into the 150-lb. steam lines, relieving the load on the 150-lb. boilers. The 350-lb. boilers may be run steadily at the most advantageous rating, leaving the 150-lb. boilers to handle the fluctuations.

In some cases it is probable that a higher initial steam pressure and temperature will be available at a future time. The turbine can be so built that it readily can be adapted to the new conditions when necessary. In other words, the way to get the most out of a bleeder turbine is to have it built for its job.

Some of the Variations in CARBON BRUSH *Specifications*

By W. C. Kalb
Engineer, National Carbon Company

Recommended Standards for Carbon Brushes *were given in the June 11 number. This article gives some of the reasons for the lack of standards and shows some of the variations in brush specifications. A third will tell the engineer some of the things he may do toward standardizing the brushes in his electrical machines.*

IT MAY well be asked why it has been possible for so many styles of carbon brushes to come into use. The primary reason for this lies, of course, in the number of points on which specifications may differ. In order that a true picture of the problem of brush standardization may be visualized and the solution approached with hope of success, it is well to consider the following points, which are largely responsible for the heterogeneous assortment of brushes now occupying the bins of the average storeroom.

First is the matter of grade. Every manufacturer of brushes lists a large number of standard grades. Many of these grades could be dispensed with to the advantage of both the manufacturer and consumer, but they are continued because there is a demand for them. A careful analysis of the situation disclosed that this demand is in many cases unjustified and that the purchaser would be better served by being persuaded to specify another grade.

It is the experience of every brush manufacturer that

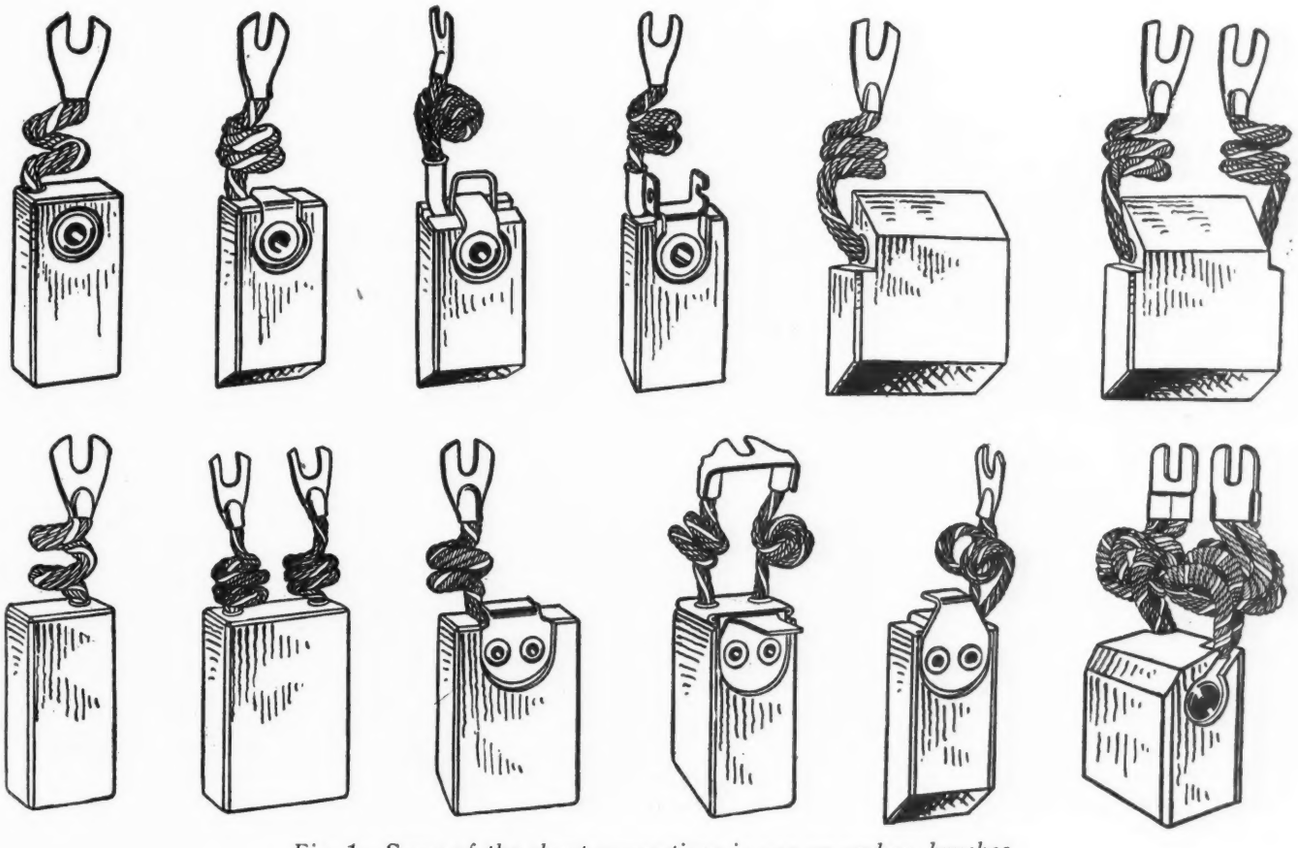


Fig. 1—Some of the shunt connections in use on carbon brushes

the major portion of his business embraces only a few of the several grades. One or another of these few grades would give equal or better satisfaction on most of the applications for which the less popular grades are specified. It can be appreciated how such a condition arises. As improved grades are developed older grades

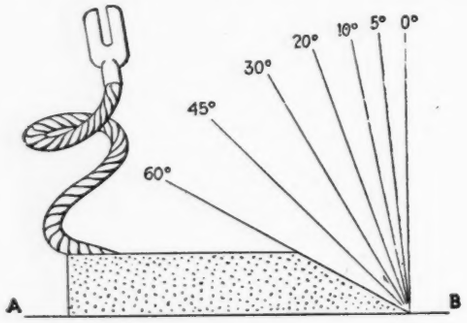


Fig. 2—Bevels on brushes

For finding the bevel of carbon brushes, place the brush on the line *AB* with the point toward *B*. The figure at the end of the line which coincides with the slanting surface of the brush shows the bevel.

continue to be specified on applications where they are already in use.

Unless this situation is faced with a certain amount of courage and insistence that the improved grade be specified in preference to older and less efficient types, the list

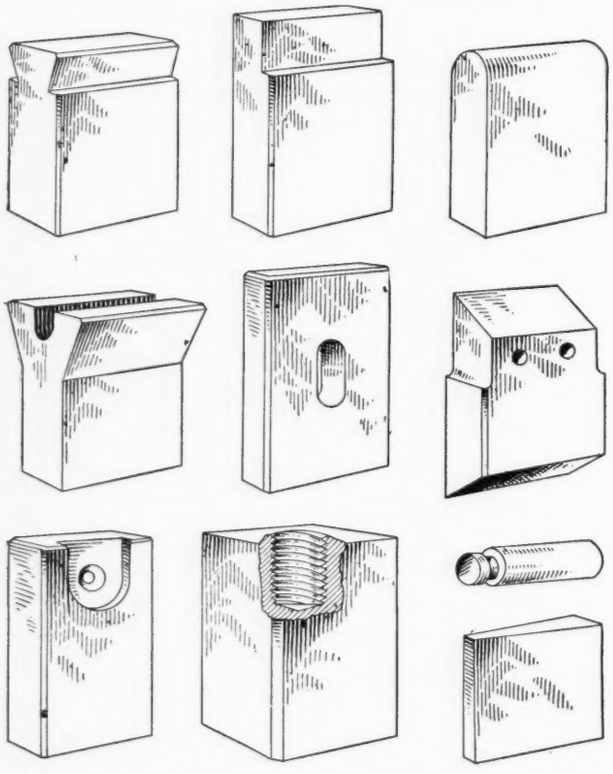


Fig. 3—Some of the holes, slots, shoulders and other forms of special work required on brushes

of standard grades steadily increases each year. If these facts are recognized, the purchaser of brushes will better understand why he is at times asked to specify a new grade in preference to one on which there has been no grounds for complaint. He should realize, too, that the temporary inconvenience of changing grade specification will work to his ultimate advantage. It would seem that twelve grades should be sufficient for any manufacturer of brushes to serve in a satisfactory manner all but a very small percentage of the applications for which his brushes are purchased. The maintenance of two or three times that number of standard grades, in order to satisfy the peculiar requirements of an occasional application, is not profitable to either manufacturer or consumer.

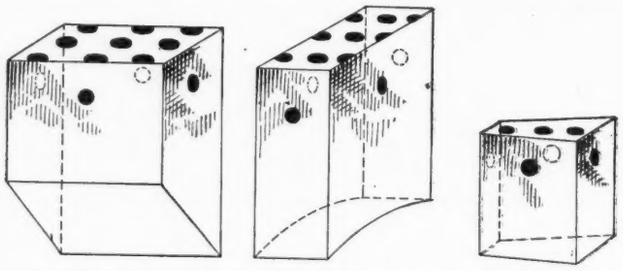


Fig. 4—Positions at which shunt connections are made to brushes

The lack of standardization of brush dimensions is another source of variation in brush specifications, accounting for even more variety in types than in brush grades. Variation in brush size is necessary in order to satisfy the mechanical and electrical requirements of the large number of designs in which motors and generators are now being manufactured. Lack of emphasis on standardization, however, has resulted in the establishment of several times the number of variations that are essential to satisfactory brush application. Close attention on the part of designing engineers to the steps recommended in the preceding article for variations in length, width and thickness, will do much toward stand-

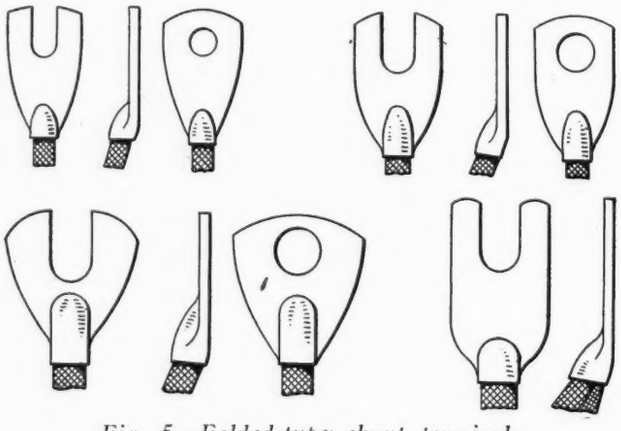


Fig. 5—Folded-type shunt terminals

ardization of dimensions in the future. The use of no tolerance limits other than those recommended by the committee on simplified practice will further aid in eliminating non-essential variations.

Brush bevels now in use cover practically the entire range from the radial brush to face bevels as high as 45 deg. Three-face angles should be sufficient for effective operation on nearly all applications—the radial brush, 15 deg. bevel for trailing operation and 35 deg. bevel for leading operation. Top bevels are subject to almost an equal number of variations. Besides the square-top brush, top bevels of 5, 10, 15, 30, 40 and 45 deg. are in common use. Three top bevels, 15, 30 and 45 deg., in addition to the square-top brush, should be

sufficient for all applications. The method of defining degree of bevel is shown in Fig. 2. Holes, slots, shoulders and other forms of special work, a few of which are shown in Fig. 3, account for many additions to the number of brush styles now in use.

Flexible shunts constitute another major factor in the multiplicity of specifications. Fig. 1 gives a few of the standard shunt connections that one manufacturer finds it necessary to supply. In addition to variations in type of shunt connection, there are thirteen positions as indicated in Fig. 4, at which the shunt may be attached to

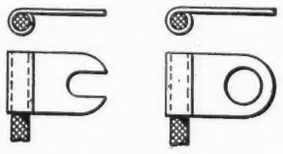


Fig. 6—Flag-type shunt terminals

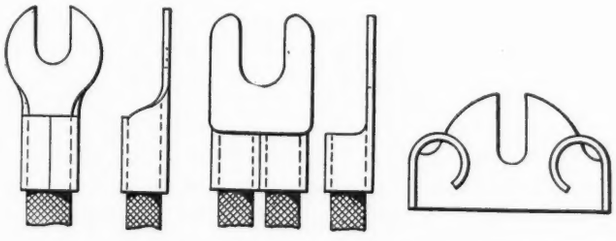


Fig. 7—Cut-type shunt terminals

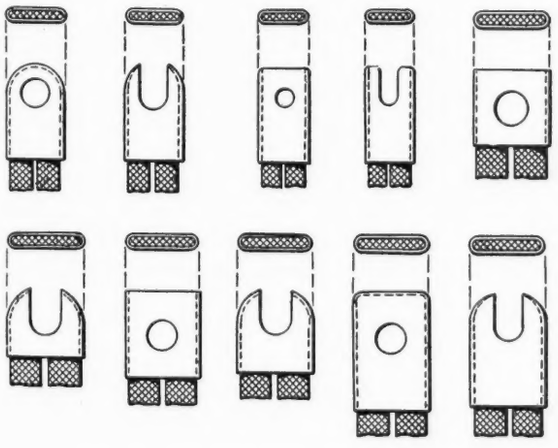


Fig. 8—Pressed-type shunt terminals

the brush. Length and size of shunt cable introduce still further variations, many of which are uncalled for.

Varied as are the styles of shunt connections, the styles of terminals run to even greater numbers. One manufacturer finds it necessary to maintain 59 standard styles and sizes of terminal connections. These are shown in Figs. 5 to 8. This would seem to be enough to meet all requirements, yet the demand of brush users makes it necessary for this particular manufacturer to stock 43 additional special types of terminals not included in the standard list.

The preceding analysis makes it evident that an almost infinite variety of combinations is possible in brush specifications and, with a view to eliminating as many of these variables as possible and restricting the application of others which cannot be dispensed with altogether, emphasizes the need for further careful study of this problem.

Equalizing Elevator-Rope Stretch

By Warren D. Lewis

WHILE as originally designed, elevators were comparatively simple in construction, the many improvements have led to various complications. With the increase in the number of hoisting ropes and the height of buildings, the problem of equalizing the load on each rope became more difficult and resulted in various methods of equalizing being tried. The shackle rods with their several inches of thread helped some, but it is difficult to adjust the tension in the ropes by this method, and when this is done it will not remain equalized for long.

While ropes from the same reel may look alike, under tension they usually display a tendency to stretch differently. Even though the stretch per foot may be relatively small, in several hundred feet it is quite noticeable and the difference tends to put more load on one rope than on another. The result is one or two ropes in a set take more than their share of the load and wear more quickly than the others, and the useful life of the entire set is reduced.

Different equalizing devices have been tried with more or less success. One of the simplest, if properly installed and maintained, is the individual shackle supported in the crosshead on the car and the counterweights on ball bearings. These bearings have been installed and later removed and their use condemned.

This device has worked successfully on high-rise cars for twenty years in one building, and it must have merit. Not alone that, but the elevator mechanics in this building favor the device. In this installation the ball bearing for each rope shackle is set in a small individual cup-like receptacle which holds oil. This lubricates the bearing and adds to its life. I have never heard of a thrust bearing being used successfully without lubrication of some kind, and I do not believe this installation would be entirely satisfactory without it. Ball bearings, when used on any device or machine, need attention if satisfactory results are to be expected, but they are worth the extra trouble.

In operation, passengers stepping on or off the cars cause the cable anchors to turn, showing that the cables are ready to adjust their respective lengths if allowed to. When starting and stopping also, the turning movement shows itself and in every way makes for better service, as it gives a sort of cushioning effect. I might add that in no case do the cables show a tendency to untwist. Still another factor is that the cables are more flexible when bending around the sheaves, as they are not held so rigid and there is less tendency to crack the individual wires.

One argument used against an installation of this type of shackle is that the turning of the cable promotes excessive wear of the sheaves. This is not borne out by the records of the cars mentioned previously. The sheave wear is no more than would be expected under ordinary operation. The traction machines in this case have shown a tendency toward sheave wear which varies with the toughness of the cable steel, a hard rope showing less wear and the sheave more than when a softer rope is used. This condition resolves itself into whether it is cheaper to renew cables oftener or wear the sheaves at a faster rate to increase the life of the ropes. The service mentioned has been obtained with 6x19 steel ropes, and has been entirely satisfactory.

Right Out of the Plant

Clean Your Lubricating Oil

I HAVE read, with interest, an article in the May 7 number by Prof. F. G. Baender entitled, "Clean Your Lubricating Oil." On page 745 Mr. Baender makes the following statement:

"Using the Saybolt viscosimeter as a standard in this discussion, the values suitable for oils for heavy gas or oil engines are: Viscosity at 100 deg. F. should be 450 to 500 seconds Saybolt and the viscosity at 210 deg. F. should be 68 to 72 seconds."

In my opinion this statement is extremely unfair to refiners of western or naphthenic-base lubricating oils, as the viscosities mentioned at 500 and 210 would entirely eliminate oils of that character. Government specifications on lubricating oils for internal combustion engines are so worded as to include both Pennsylvania or paraffin-base oils and Western or naphthenic-base oils. Many products of the latter class are on the approved list of makers of the largest types of Diesel and gas engines.

W. L. STANDARD.

Los Angeles, Calif.

Constructing a Power-Plant Extension Under Difficulties

A PROGRAM that calls for extension of the intake water system, erection of a substation, building of a tunnel from the main plant to the new substation, installation of a steam-turbine generating plant and powdered-fuel system, is now being executed by the New Brunswick Power Company at St. John, N. B.

Cognizance of the necessity of operation of the power plant for 24 hours every day has been taken in the plan used in the extending of the intake system. The water supply for the generation of steam had been obtained from an intake in a harbor slip, near the plant. Extension of about 130 ft. to the intake system is being made, right out to the harbor line or opening of the slip. There are two sections of 42-in. cast-iron pipe and a screenhouse.

It being essential that the power plant be maintained in operation continuously day and night, it was out of the question to utilize the usual methods of underwater construction, and it was not feasible to use a cofferdam. The engineer in charge of the program of construction and installation found himself facing a formidable problem, particularly in the building of the screenhouse, the bottom of which was to be 14 ft. below dead ebb tide. The plan finally decided upon was to use two derrick scows and build the screenhouse between the scows on cables connected with the donkey engines on the scows, lowering the screenhouse down into the water as it was built. The first task was to build the bottom of the screenhouse. The dimensions of the bottom are 14x20 ft. and 2 ft. thick, two decks of 12x12 timbers being used.

Next came the making of the wooden forms for the reinforced concrete sides, then the pouring of the concrete.

When the walls attained a height of 15 ft., the screenhouse rested on the foundation that had been provided before the body of the house was started. The foundation consisted of 35 piles which had been driven into the mud of the slip. At fifteen feet, the walls were two feet above the surface at ebb tide, and the remainder of the work of construction was continued between the tides, which are abnormal in the Bay of Fundy. In the harbor into which the intake system has been extended, the tide rises and falls as much as 35 ft. When completed, the screenhouse will be 49 ft. high, divided into a pair of wells, each with separate gates in front so that either pipe line will be available. In the extension of the pipe line 12x12-in. timbers were used. These were placed in bents, and each timber rests on three piles.

A new substation is also included in the program. It is being built on the wharf and will connect with the main power plant by a tunnel that will run under a street and a large warehouse. Four of the old boilers in the main power house have been taken out to provide for the excavation for the new pulverized-fuel system. A section about 50x50 ft. was dug up 10 ft. below the boiler-house floor. Then, directly under the new boiler, an extra depth of 9 ft. had to be attained over an area 20x20 ft. This work was below high-water mark much of the time, and bulkheads were built to enable the job to be continued.

St. John, N. B., Canada. WILLIAM J. MCNULTY.

Does Internal Drum Resistance Affect Accuracy of Prony Brake?

ON page 714 of the April 30 number is illustrated and described a "Practical Cooling System for a Prony Brake." The device is ingenious, but one wonders whether the added innovations do not defeat the purpose of the test—at least the purpose of demonstrating the theory. For instance:

1. Where is the mechanical energy measured that is transformed into heat energy by the movement of the $\frac{1}{2}$-in. pipe at high speed through the water in the drum?

2. Is this radial section of pipe really necessary? Obviously, if the $\frac{1}{2}$-in. pipe were merely extended into the center of the drum to a point near the end of the shaft, the heavier cold water would immediately be thrown to the periphery, where it would force the hot water to the center to be discharged, thus circulating by convection.

3. Question 1 also applies to the kinetic energy of water thrown off at high velocity from the end of the discharge pipe.

4. In short, can there be permitted any resistance to the motion of the drum, except through the Prony brake itself, and still obtain a correct result?

These questions are more or less academic and may not materially affect the results. However, they might do so, since any departure from theoretically correct practice will result in error, depending on the degree of departure.

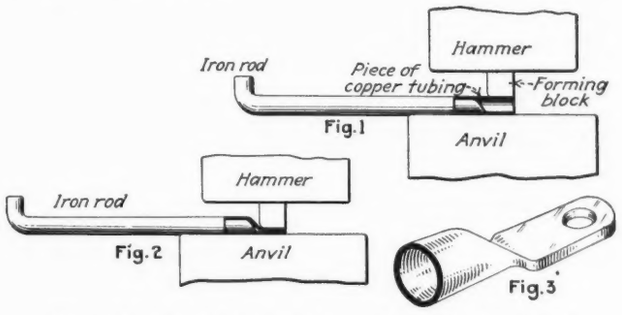
Possibly the professors of the University of Colorado recognize and allow for the errors. If not, it would seem the principle of the Prony brake is not thoroughly understood.

RAY W. EDSON.

Dallas, Tex.

Cable Terminals Made from Copper Tubing

WHEN copper cable terminals are needed in a hurry and are not available, they can readily be made from a piece of copper tube. If neither a power hammer nor a press is available to form the terminals, they can be shaped by hand. Figs. 1 and 2 show the terminals being formed by a power hammer and Fig. 3 is a terminal.



Figs. 1 to 3—Method of forming cable terminals from copper tubing

The terminals are made of copper tubing of standard pipe size for the smaller sizes and heavier tubing for the larger sizes. For a former, a piece of steel or iron rod about the same diameter as the outside of the tubing, is turned down at one end to fit the bore of the tubing. The turned end is shaped as shown in the figures. The other end of the rod is bent so that it can be knocked out of the terminal after it is formed.

Long Beach, Calif. E. J. JORDAN.

Interlock System for Coal-Handling Equipment in an Industrial Plant

THE coal-handling equipment of a certain industrial plant consists of a crusher, an elevator and a distributing conveyor, as illustrated in Fig. 1. The elevator and conveyor are each operated by a 7.5-hp. motor, while the crusher is driven by a 30-hp. motor. As

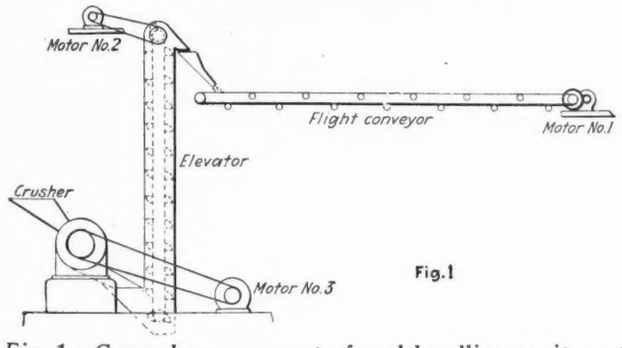


Fig. 1—General arrangement of coal-handling equipment

a shutdown of the conveyor with the crusher and elevator running, or a shutdown of the conveyor and elevator with the crusher running, would tie up the system and cause considerable inconvenience, the interlock system shown in Fig. 2 was installed.

The magnetic switch on No. 1 motor acts as the master switch for the complete equipment, and motors 2 and 3 cannot be started until No. 1 is running. Either No. 2 or No. 3 can be stopped by pressing their individual stop buttons, while pressing the stop button on No. 1 shuts down the three motors. If for any reason No. 1 motor stops, all three stop, and it is impossible to start either No. 2 or 3 until No. 1 is again running.

By cutting the control circuit to the start-stop button of motor No. 3 at the arrows, shown at *A*, Fig. 2, and connecting this control circuit as indicated by the dotted lines, it is impossible to start No. 3 motor until No. 2 is running, and also impossible to start No. 2 until No. 1

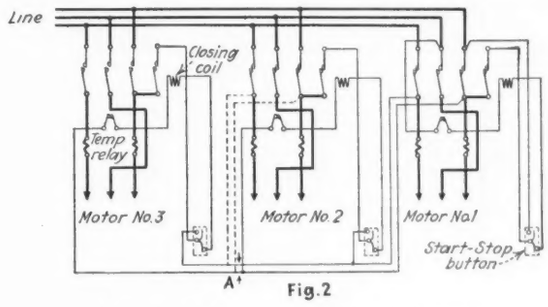


Fig. 2—Diagram of interlock system

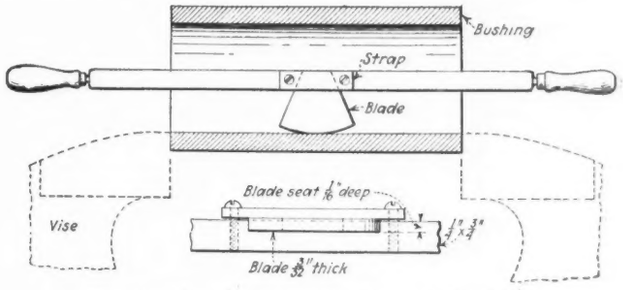
is running. This system can be worked on any number of motors. The control equipment can be installed away from all dust and dirt, and the only exposed parts are the push buttons, which can be placed in any convenient position. This system costs considerably less to install than compensators and, since it is foolproof, it saves considerable time and inconvenience and possible damage to equipment.

Port Arthur, Ont., Canada. J. S. E. STAFFORD.

Bearing Scraper with Renewable Blades

THE type of bearing scraper shown in the illustration has many advantages over the conventional half-round tool. The pressure on the scraper can be regulated with both hands from opposite sides of the bushing or bearing. In this way not only greater speed can be attained, but the high spots can be removed without coming in contact with an existing low spot.

It is made from a piece of cold-rolled steel $\frac{1}{4}$x$\frac{1}{2}$ in. and 10 to 12 in. long. The bar is pointed at both ends to form a tang, to which file handles are fitted. At the



Scraper handle extends through bushing

center an angular seat is milled or filed to take the cutter. The seat should be about $\frac{1}{16}$ in. deep. The angular shaped cutter is made of tool steel about $\frac{3}{32}$ in. thick, properly tempered. It is made to conform with the corresponding seat in the holder. A strap secured by two machine screws holds the blade in place.

Syracuse, N. Y. H. L. WHEELER.

Why the Architect Should Not Design the Power Plant

THE article by Frank L. Gilmore in the March 26 number on "Common Defects Found in Newly Installed Heating Systems," and the comments by Paul F. Rogers in the April 23 number on "Why the Architect Should Not Design the Power Plant," were read with considerable interest. It is my opinion that neither one goes far enough.

The average architect is lost when he tackles any mechanical work whatsoever outside of a house job.

For the last eight years I have had charge of the mechanical and electrical work in the office of a consulting engineer, who maintains both a structural and a mechanical department. On several occasions where a consulting engineer has been called in by the owner to check plans prepared by an architect, he has saved the owner thousands of dollars on structural work alone. In one case the steel designer had used special beams for about two-thirds of his structural work, where by a little figuring and some changes in the structural design, the consulting engineer substituted all standard shapes and saved the owner $39,000.

When it comes to mechanical equipment, the following was copied from a specification out of an architect's office:

> It is the intention to install a low-pressure vacuum steam system using both radiation and units to heat all parts of the building to 72 deg. F. in zero weather. . . .
>
> Each contractor shall submit with his proposal a plan showing the size and location of the direct radiation and heating units, together with the location and size of steam supplies and returns.

The plumbing and electrical specifications were along the same order: "Plumber shall submit a sketch showing the size and location of all hot and cold water, circulating lines, sewers, etc." Each contractor got a set of plans, laid out his own job, and submitted a bid. The architect got a commission from the owner for something he did not do (his contractors did it for him). Incidentally, the less said about the kind of a job the owner gets, the better for all concerned, yet this kind of business is being practiced all over the country. If an architect cannot tell a contractor what he wants, he should let someone handle it who knows how.

On one large office building I know of, the architectural work went to a prominent firm of architects, while the structural steel, elevators, plumbing, heating, fire protection, electric wiring, telephone and telegraph, fire alarm, electric clock and pneumatic tube system, went to the consulting engineer, who was in on the job from the start and worked with the architect on an equal basis in planning the building. The result was one of the finest examples of a modern office building to be found anywhere in the country. On the electrical plans every circuit was shown back to the panels and every feeder back to the switchboard, and all figured for line drop. All other mechanical plans were complete with every pipe line and valve shown on the drawings. Provisions were made so that plumbing fixtures or electrical equipment can be installed in any office, anywhere in the building, without exposing a single pipe or conduit. Incidentally, credit for this should go to the engineer, who sold the idea to the owner, and who instructed the architect to design the building accordingly.

When more owners realize that it costs no more to have an engineer do their mechanical work than it does to have an architect turn it over to the tender mercies of a contractor, conditions in the industry will improve immensely.

Let the owner say to the architect: "You are to have charge of the architectural work, namely, general architectural design, mason work, carpentry, roofing, painting, etc. Our consulting engineer will work with you, perhaps offer some suggestions in planning, and will design the steel and all mechanical equipment."

In designing the steel, provisions are made for supporting any mechanical equipment necessary, such as elevator machinery, water-storage roof tanks, etc.

The engineer and architect each draw their full commission on the work they do, the only difference being that it is split between two men, the cost to the owner being the same. Incidentally, the owner gets a much more satisfactory job than he will if he lets the entire work to an architect, who either hires an engineer, as Mr. Rogers says, or makes his contractors do his engineering for him.

FRANK L. WADSWORTH,
Mechanical Engineer,
with S. Firestone, Consulting Engineers.
Rochester, N. Y.

Cutting and Welding Torch an Important Power-Plant Tool

OF THE many machines and tools now available for repairing and maintaining power-plant equipment, the oxyacetylene blowpipe and cutting torch, in my opinion, takes the prize.

Last year I installed two 60-in. x 18-ft. boilers for a heating system. The heating mains were carried through an underground tunnel 520 ft. in length, and all piping that was used had been salvaged from another tunnel after 18 years of use. Some of this pipe was pitted badly and these places were built up with the torch. The ends were cut off and the lengths of pipe were welded together. The pipe varied in size from 1½-in. to 6-in., and no fittings were used except at the reducing valves and expansion joints.

This method of fitting is much faster and costs less than threaded joints and is less likely to leak when the steam is turned on. To weld seven joints of 6-in. pipe about 100 cu.ft. of acetylene is required, 2½ lb. of filler rod and from 25 to 35 minutes' time to each joint. Branches are readily taken care of by cutting a hole in the pipe and welding in a short nipple without taking down the line. A 2-in. hole can be cut out and a nipple welded in place in less than one hour.

I find the torch a handy tool for heating rivets when erecting steel I-beams and supports. We put the rivets in place, then heat them to the right glow with the torch in just a few seconds. In pipe bending, up to 2 in. in diameter, you can get the heat just where you want it with the torch, and it is surprising how easy the bending can be done. In refrigeration work it is one of the best means of pipe fitting I know of, as it does away with nearly all flanges and fittings and reduces the chances of leakage from bad gaskets or poor threads.

To appreciate the advantage of welding one has only to be given the job of installing a set of ammonia condensers where the space is limited. By using the torch you can place the suction header where you want it, cut out the holes to fit each stand of condensers and weld them in place.

EMILE J. TURGEON.
Sioux Falls, S. D.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

New Switchboard Instruments Have No-Glare Glass

THE use of a special glass which prevents glare is one of the features of new instruments for switchboards introduced by the General

Rectangular meter permits close mounting

Electric Company, Schenectady, N. Y. The special glass, in combination with anti-parallax scale and pointer, facilitates reading regardless of the angle from which the instrument is viewed.

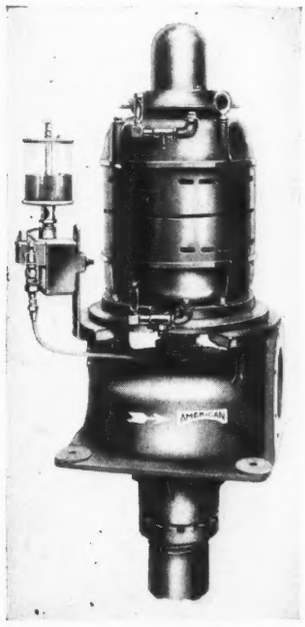
The new line of instruments is uniform in size and appearance for both alternating-current (Type AD) and direct-current (Type DD) ammeters, voltmeters, wattmeters, reactive volt-ampere meters, power-factor meters, and frequency meters. They are listed in standard commercial frequencies, but special ratings and scale markings can be furnished.

The instruments are 6 in. high, $5\frac{1}{2}$ in. wide and $3\frac{1}{2}$ in. deep, making it possible to mount four instruments across a 24-in. switchboard panel. They are back-connected and equipped with mounting studs to support the instrument on the switchboard.

Voltmeters, wattmeters, power-factor meters and reactive volt-ampere meters have the resistors inclosed in the instrument cases. An exception to this is the wattmeter for voltages in excess of 140, which are supplied with external resistors. Both alternating-current and direct-current instruments have electromagnetic damping.

Deep-Well Turbine

NEW deep-well turbines in 6 and 8-in. sizes, designed especially to fit the smaller bored wells, is announced by the American Well Works, Aurora, Ill. The new unit consists of the turbine head proper, which is the driving unit, the supporting pipe, which incloses the driving shaft, and the turbine itself, which consists of the number of



Pump head with electrically controlled oil feed

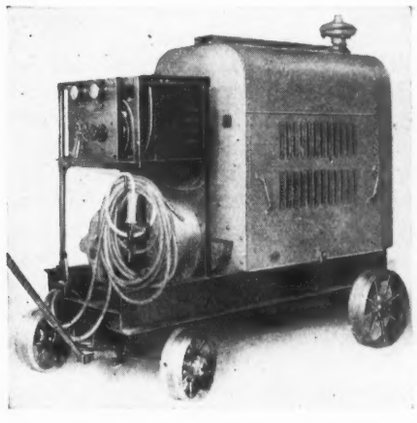
stages necessary for the specific requirements of the well in which it is to be used.

The driving head is a vertical motor equipped with a thrust bearing designed to carry the load of the line-shaft and impellers. It is attached to the supporting pipe, to the lower end of which is attached the turbine proper. The turbine is a special style of turbine-type centrifugal. All bearings are oil lubricated by gravity feed from the surface, the feed being electrically controlled. Provision is made for complete drainage of all waste oil and water leakage, and the discharge pipe is located above the floor level.

Gas-Engine-Driven Welder With 20 to 600 Ampere Range

FEATURES involved in the type-S gas-engine welder illustrated are: A range of 20 to 600 amp., narrow frame, and portability. It is adapted to both heavy current and large diameter electrodes for rapid depositing of metal, and also to a short arc with close control of the welding current for welding and repair work. It is also claimed by the manufacturer, the Wilson Welder & Metals Company, Hoboken, N. J., that close control and quick voltage recovery make the machine suitable for overhead welding, and also the welding of thin sheet metal.

By setting the pointer on the control panel and adjusting the open-circuit voltage by means of the field rheostat, any desired current value



Gas-engine driven welder mounted on truck

can be obtained. The generator is self-excited. The reactance provided automatically steadies the arc under all welding conditions. The machine is capable of turning out work with metallic electrodes up to $\frac{1}{2}$ in. in diameter and with carbon electrodes up to $\frac{3}{4}$ in. in diameter.

Electric Motor Drive for Single-Retort Stokers

THE type E and type K underfeed stokers manufactured by Combustion Engineering Corporation, New York, are usually steam driven. For installations where the steam drive would be impractical, as for instance, where the operating steam pressure is below 60 lb., a motor drive has recently been developed which is applicable to either of these stokers.

Motor drive for Type E and Type K stokers

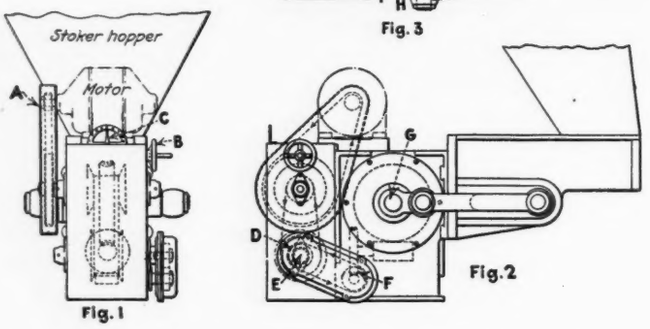


Fig. 3

Fig. 1

Fig. 2

The new drive consists of a double worm-gear reduction unit and a Reeves variable-speed transmission unit. The motor is located on the top of the gear case. In this position it is removed from the usual floor dirt of the boiler room, and access to the firedoors is not obstructed by the motor and its foundation.

The variable-speed transmission is driven by a silent chain from the motor, as shown at *A* in Fig. 1, and on the opposite side, at *B*, is a handwheel for adjusting the speed changes. The ratio of speed change is from 1 to 8. For indicating the relative speed a pointer device is mounted as shown at *C*.

Fig. 2 is a side view of the drive. A silent chain *D* connects the lower shaft *E* of the variable-speed mechanism with the first worm-gear reduction *F*, from which power is transmitted through the double set of worm gears to the crankshaft *G*. On each end of the crankshaft are cranks *H* from which twin connecting rods transmit power to the under side of the pusher block of the stoker. A safety device, in the form of a shear key, is provided to protect the stoker mechanism from breakage in case the stoker feed is obstructed in any way. This shear key, located at *K*, is on the outside of the casing, where it is convenient for replacement.

When a steam-pressure regulator is used to give automatic control of the stoker speed, a lever is substituted for the hand-wheel control *B* of the variable-speed device. The electric drive has been designed so that either high-speed or low-speed motors can be used.

New Return Bend Facilitates Tube Cleaning and Renewal

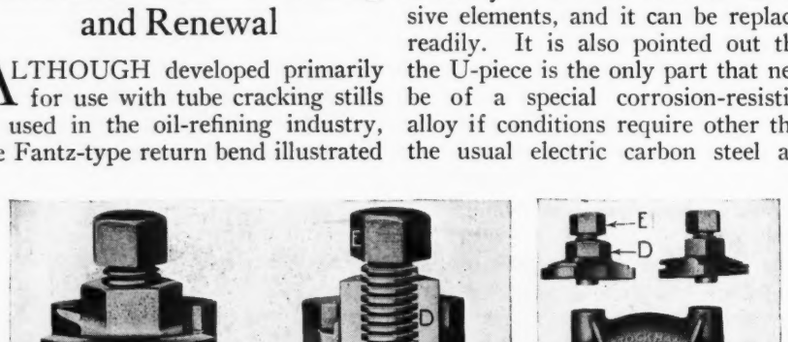
ALTHOUGH developed primarily for use with tube cracking stills as used in the oil-refining industry, the Fantz-type return bend illustrated is adaptable to uses in power plants and other industries.

The bend, which is manufactured by the Stockham Pipe & Fittings Company, Birmingham, Ala., has been especially designed to reduce the time the unit must be out of service for replacement or cleaning of the tubes, and to increase the safety factor.

Referring to the partial section Fig. 1 and the group of parts Fig. 2, the construction of the bend will be readily understood. Tubes are inserted through the tube sheets. The yoke *A* is placed over a pair of tubes; the split rings *B* are placed in the yoke; the yoke and rings are slid back against the upset ends of the tubes; the U-piece *C* is then placed over the tube ends and a tight joint is made by means of the toggle *D* and lock screws *E*. In this assembly the tube ends, instead of being rolled in cold, are upset in the fabricating shop, or at the mill, at the proper forging temperature to insure the best physical structure of the tube material. This permits the use of special alloy or treated tubes without the objections that have heretofore been encountered.

The type of ring joint used gives a joint that is readily broken should it be desired to revolve or to remove a tube, and the work can be done without destruction of tubes by cutting or damage to the assembly.

The U-piece is the only part of the assembly in contact with the corrosive elements, and it can be replaced readily. It is also pointed out that the U-piece is the only part that need be of a special corrosion-resisting alloy if conditions require other than the usual electric carbon steel and consequently, it is the only part that should need renewing. The return bend is manufactured to meet any specifications for pressure, temperature, tube diameter and tube spacing.



Partial section and view of return bend disassembled

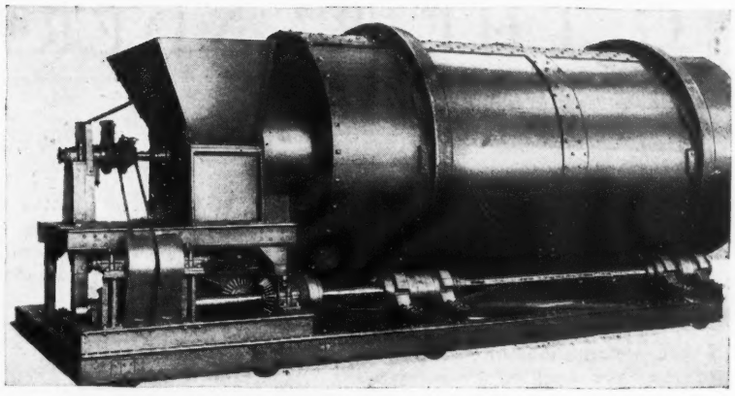


Fig. 1—Duncan Rotary sludge burner

Rotary Sludge Burner

PETROLEUM refineries and other industries of a similar character have long faced the problem of disposing of unusable viscous by-products such as acid coke and some of the other sludges. Owing to their acid condition the handling of these sludges is an unpleasant job, and because of the change in physical properties of these materials with a variation in temperature, it has been practically impossible to hand-fire these byproducts efficiently for still or boiler heating or to burn them on mechanical stokers.

To meet the demand for a burner that would not only dispose of the unusable combustible waste matter but make it feasible to utilize the heat of burning in boilers or stills, the Illinois Stoker Company, Alton, Ill., has developed a rotary burner that is a radical departure from standard types. In construction it resembles a small rotary kiln consisting of a cylindrical steel shell lined with firebrick. It is mounted on wheels in front of a boiler furnace in a nearly horizontal position, and rotated slowly by means of a motor or engine drive through two pairs of trunnions. The general construction of the burner may be seen in the exterior view, Fig. 1.

At the rear end of the burner is a hopper to receive the material to be burned and a variable-speed screw conveyor to push it into the burner. As the material falls from the screw conveyor in large and small pieces and also in the liquid state, high-pressure air or steam jets blow on it at an angle of about 45 deg. The air from these jets produces a hot zone about three feet long at the feed end of the burner. In this zone the volatile portions are vaporized and burned as gases in the early part of the cycle. The larger pieces of material are coked before they melt into a liquid, while the smaller pieces and the liquid portion of the feed are blown and sprayed out toward the discharge end of the burner. Particles of this sprayed mass that do not burn while in suspension, fall on the rolling mass of coke that is made up from the larger pieces. By the rotation of the burner the material is continuously agitated and in this way the fuel is brought into contact with the hot refractory lining, causing it to crack to gas and coke.

To burn the gases, air is admitted above the fuel line, passing from a forced-draft fan through a series of vanes that give it a spiral motion, so that it hugs the burner walls and in passing over the coke and any melted oils that may stick to the burner lining, furnishes the oxygen for combustion. To advance the burning of plastic or semi-fluid material that tends to remain en masse at the bottom of the burner, tuyeres are located below the fuel line and high-pressure jets of air or steam are directed against the plastic mass to agitate it until such time as the fuel is cracked to gas and coke by the heat of the kiln walls.

Rotation of the burner rolls the fuel mass over and over, advances it toward the front of the burner and breaks up the coke. The forced draft picks up the small coke particles and ash and carries them into the boiler combustion space. The forward end of the burner is restricted in size to hold the solid fuel in the kiln until it is entirely consumed. At the furnace end of the burner the unburned portion of the hot gases mixes with secondary air from the fan as it is being discharged into the combustion chamber of the boiler. If preferred, the burner can be operated as a gas producer and the gas generated burned in the boiler furnace proper by the admission of sufficient secondary air.

For still and boiler heating purposes burners have been built ranging in capacity from 500 to 4,000 lb. of sludge per hour. Fig. 2 shows a typical installation of the capacity last named attached to a 5,500-sq.ft. boiler. The wet sludge is picked up from the storage pit by a monorail crane, dumped into a storage hopper behind the burner and transferred to the small feed hopper on the burner by means of a variable-speed, motor-driven drag-chain conveyor that breaks up the sludge into small lumps during transit. The burner has a shell ½ in. thick, 6 ft. in diameter and 15 ft. long. The speed of rotation is 20 revolutions per hour. Sufficient gas is burned at all times (about 6,000 cu.ft. per hour) to insure ignition of the heavy fuel.

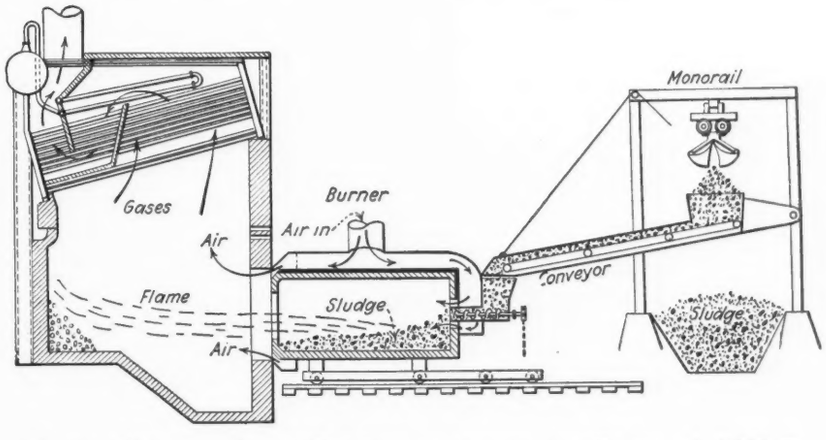


Fig. 2—Diagram of centrifugal rotary burner installation of 4,000 lb. per hour capacity serving a 5,500-sq.ft. boiler

FROM AMONG THE READERS'

Conducted
By
L. H. Morrison

ROOF COOLING POND—*Is it possible to place a spray pond on the roof of a twelve-story building when the engines are in the basement, without an excessive pumping cost?* P. C. C.

Yes; the return line to the condenser and the discharge line from the condenser to the roof will balance, so that the pumping load will consist of the power to overcome the pipe-and-tube friction, plus the spray-nozzle loss. The condenser, however, must be designed to withstand the pressure due to the total head of water in the water compartments.

RECEIVER FOR COMPOUND ENGINES—*What should be the capacity of a receiver between the high- and low-pressure cylinders of a steam engine?* F. P.

At one time a very definite ratio of receiver capacity to high-pressure-cylinder volume was used by engine designers. But about 25 years ago it was found that the receiver could have almost any volume, for the piping between the cylinders afforded all the capacity needed to absorb fluctuation in the steam pressure. In fact, many cross-compound engines have no receiver and a tandem-compound never is so provided.

PERMISSIBLE BACK PRESSURE FOR HEATING FEED WATER.—*To what extent is it economical to increase the back pressure of a non-condensing engine for raising the temperature of boiler-feed water delivered by an exhaust-steam feed-water heater?* C. D.

Within moderate limits the total steam consumption of an engine increases substantially in direct proportion to the increase of the load, or increase of mean effective pressure, and each additional pound of average back pressure increases the total steam required for a given load the same as though the load had been increased to require as much additional mean effective pressure as the added back pressure. Under average conditions, where an exhaust-steam feed-water heater is employed only for heating water for generation of steam supplied to a non-condensing engine, for one pound of additional back pressure on the engine there will be obtained an increase of about three degrees additional temperature of feed water, depending on the efficiency of the exhaust-steam feed-water heater, and for each degree of feed water there will be a saving of about one-tenth of one per cent of heat required for generation of the steam used by the engine. Under these conditions the limit of advantage is reached when the cost per degree increase of the feed water is one-third pound per square inch of additional back pressure, and when for each degree rise of feed-water temperature the increase of back pressure amounts to one-thirtieth of one per cent of the mean effective pressure.

CYLINDER RATIOS OF COMPOUND ENGINES—*Is it considered practical to construct and operate compound engines with a cylinder ratio as high as 6 to 1?* C. R.

In a cross-compound engine it is desirable to divide the load equally between the cylinders and then make the cylinder ratio such as to sustain the least drop of pressure between the cylinders and the least loss from range of temperatures in the cylinders. For present-day boiler pressures of 150 to 200 lb., this can be accomplished with cylinder ratios between 4½ and 5 with variation of load between one-half and full load.

Ratios between 6 and 7 have been used on special engines with good economy when operated with loads and steam pressures appropriate for the ratio. These engines were marine and water-works engines carrying uniform loads. For stationary cross-compound engines with variable loads the smaller cylinder ratios have given better results.

CHATTER AND BLOWDOWN OF SAFETY VALVE—*Why does a safety valve continue to blow off after the boiler pressure has dropped below the pressure for which the valve is set? What would cause a safety valve to chatter or rumble when blowing off?* F. R. M.

Blowing off continues after the boiler pressure is reduced below the "pop" pressure because the discharge passages guide the escaping steam in such a manner that it helps the boiler pressure to hold the valve away from its seat. The greater this assistance while the valve is open the lower the boiler pressure will be reduced below the "pop" pressure before the valve will be closed. The reduction in boiler pressure below the "pop" pressure is called the "blowdown" and most direct spring-loaded safety valves are provided with an adjustable "blowdown ring" or other means for varying the amount of blowdown.

When the valve is raised from its seat the pressure exerted by the spring is greater than when the valve is closed. Hence, when the valve opens, unless the escaping steam exerts enough force to overcome the greater spring resistance, for continuance of a little more than pop pressure in the boiler there are rapid alternations of partial openings and closings, due to the rebounding of the spring and small sudden changes of boiler pressure that give rise to chattering of the valve with intermittances of discharge, causing vibrations of the atmosphere that produce a chattering or rumbling sound.

ADVANTAGE OF SUPERHEATED STEAM FOR RECIPROCATING ENGINE—*How is advantage gained by the use of superheated steam for a reciprocating engine?* L. G.

The principal advantage is derived from prevention of initial condensation. The higher the degree of superheat the drier the steam at cutoff, and by sufficiently superheating the steam supplied to an engine, it is possible to prevent any cylinder condensation and deliver dry or superheated steam during the exhaust. By using superheated steam, single-cylinder engines which are subject to large losses from cylinder condensation when supplied with saturated steam, may be operated successfully through a greater range of expansions and such an engine may be run economically with either a light or a heavy load.

RUNNING PUMPS UNDER A BACK PRESSURE—*I have charge of a plant where we are operating four reciprocating direct-acting steam-driven pumps exhausting to the atmosphere. We also have two generators for an absorption refrigeration plant and two large domestic heaters for heating water. The generators and heaters are being operated on high-pressure steam. I find by putting a back pressure of 20 lb. gage on the exhaust of the four pumps, I can operate the generators and hot-water from the exhaust from the four pumps. The steam, after leaving the generator and water heaters, is discharged into a 7-in. vacuum. Will it be more economical to operate the pumps with no back pressure and the generators and heaters on line steam, or to operate the pumps with 20-lb. back-pressure and exhaust into the hot-water heaters and generators?* R. S. M.

Without going into the exact savings in B.t.u. possible through the charge, a decreased steam consumption will exist if the pumps are run against a back pressure, discharging into the ammonia generator. It is assumed that the pump steam cylinders are large enough to operate the water ends when the back pressure is raised to twenty pounds.

Each pound of steam entering the pump cylinder contains, when it leaves the exhaust port, all the internal energy at the entrance pressure.

PROBLEMS

ANSWERS

from Our Readers

THE QUESTION

AT what boiler pressure does the usual glass gage prove unsatisfactory?

THE pressure at which the ordinary tubular gage glass proves unsatisfactory is largely a question of how much trouble one wants to put up with. At 350 lb. pressure a good gage glass should last about a month, while at 400 lb. pressure its average life is reduced to about two weeks.

Equipment with a life of only two weeks has no place in a boiler house, and for pressures of 400 lb. or more other types than tubular glass should be used.

The life of a boiler gage glass decreases as the pressure increases, largely because of the greater scouring action of the higher-temperature steam as it condenses at the upper end of the glass. This action dissolves the glass until it becomes too thin to withstand the steam pressure, and failure occurs.

There are, of course, other causes of gage-glass failure. Improper alignment of gage-glass fittings, gland nuts that do not fit properly, and careless installations are common causes. Cold drafts of air and too sudden admission of steam are some of the other reasons for breakage.

For pressures above 400 lb. it has become common to use the flat gage glass. The inside surface of the glass plate is lined with mica to protect it from the dissolving action of the water and steam. After several months of service the mica becomes fogged and must be replaced in order to make proper observations of the water level possible. M. H. DRISCOLL.

St. Louis, Mo.

THE question admits of no clear-cut answer, for the reason that the quality of the boiler feed plays an important part in gage-glass breaking. If the water contains any acid that is corrosive to glass, the gage will break quickly, regardless of the pressure. Even low-pressure boilers are not immune.

High pressures, say above 450 lb., increase the tendency of the corrosive action, and even if the water be chemically neutral, the steam condensing in the glass seems to corrode the glass in grooves. Probably 450 lb. is the limit, although many plants of that pressure experience no excessive breakage.

Much of the trouble under low-pressure conditions is due to carelessness in glass replacement. If the rubber rings are not placed correctly, the gland may so bind the glass as to set up strains that cause the glass to break as soon as steam is turned on. JOHN MILLS.

Camden, N. J.

THE usual round gage glass has an upper limit of use at about 450 lb. pressure. This type of glass demands such particular care at this or higher pressures that its use is not feasible. Slight defects in the glass, a little carelessness in installation or an apparently inappreciable draft of air, all make failures frequent and dangerous.

Perhaps the greatest cause of trouble with these glasses is carelessness in installation. Omission of a spacer, too much tightening of the packing nuts, not allowing the glass to warm up properly before cutting it in or a half-dozen other causes conspire against long life of the round glass.

Flat gage glasses held between forged steel frames, have a practically indefinite life if their inner surfaces are protected against chemical action by the boiler water. The glass will need cleaning occasionally, for which it must be taken apart. This type of glass should be illuminated from behind for best results. R. H. SOGARD.

Topeka, Kan.

THE pressure at which the ordinary gage glass proves unsatisfactory has no fixed value for all plants. In one plant the operating force may not be unwilling to replace glasses every week, while in another plant a life of a year may be insisted upon. It has been found that with 300 lb. pressure the average life is about six weeks, and that practically all, if not all, boilers of less than 300 lb. are fitted with the ordinary round gage glass. For pressures above this value some form of flat-glass gage is recommended.

Many reasons are advanced for glass breakage. The glass may be out of line, the packing nuts may not fit properly, or the packing rings may be too hard or fit too tightly. There is also trouble from drafts, but this can be avoided by shields.

As the pressure increases, it is usual to use gages with thicker walls, but there is a limit to this, for extremely thick round glasses have a tendency to split lengthwise, due no doubt to the hoop stresses set up by temperature changes. It has also been found that glasses obtained from the makers of proper length last longer that those cut by the engineer. It seems that when the pressure is over 300 lb. a flat type of gage is better.

These flat gages may or may not have a protective transparent back, such as mica. If so protected, the mica will fog in time, requiring replacement, the glass itself remains unaffected.

If an unprotected flat glass is used, it will in time corrode, but as it can be made as much as one inch thick, breakage seldom occurs. The glass fogs or becomes somewhat opaque in time.

What is needed is a form of water column in which some indicating means, other than a glass gage, is used. Of course, various state and municipal rules call for a gage glass, but are these not as archaic as rules preventing the use of welded joints?

There is no engineering reason why a water column could not be fitted with a series of thermocouples arranged to indicate on a dial the water level. Still another plan could embrace the adoption of the usual feed-water regulator; this is now depended upon to keep the level constant, why not have it also indicate the level? The objectionable time lag could be eliminated by redesign.

Jersey City, N. J. JOHN CASSIDY.

EXPERIENCE indicates that the ordinary tubular gage glass is not suited for use with pressures much above 400 pounds. At this pressure the average gage glass breaks within 10 to 14 days after installation.

CHESTER SMITH.

Los Angeles, Calif.

A Question For Our Readers

WE HAVE a centrifugal pump that was designed to handle 300 g.p.m. against a 100-ft. head, direct connected to a 1,750-r.p.m. motor. Can we run the pump against a 50-ft. head? What alterations are necessary?

A. M. P.

Suitable answers from readers will be paid for and published in the July 23 issue

At A.I.S.E.E. Convention

COMBUSTION PROBLEMS

Were an Outstanding Feature

MORE efficient utilization of fuel and waste heat has been of growing interest to steel-mill engineers during the last eight or ten years. This interest was clearly demonstrated at the sessions devoted to discussing these problems at the 25th annual convention of the Association of Iron and Steel Electrical Engineers, held in the William Penn Hotel, Pittsburgh, Pa., June 17 to 21. A total of nine technical sessions were held, of which three were devoted to combustion, thirteen papers being presented on this subject.

Better utilization of steam; some results of boiler-water conditioning; efficiency versus economy; gas utilization; combustion of liquid fuels; economizers; some of the business aspects of furnace manufacturers; gas producers; and the application of pulverized fuel to industrial furnaces were subjects considered at the three meetings held by the combustion engineering division. The incorporation of safety in power-plant design, another subject discussed, is of interest to power engineers. A miniature locomotive controlled by spoken commands given over the radio was a feature of the convention's opening.

Besides the technical sessions, the power-equipment exhibit was an important part of the convention. Over 150 exhibits of various classes of equipment used in the generation and application of power in the iron and steel industry were shown. The exhibits occupied a large part of two floors in the hotel, and the convention was one of the most successful ever held by the association, with over 1,500 members and guests registered.

J. A. Farrell Opens Convention

The convention was officially opened on Monday evening with a short address by James A. Farrell, president of the United States Steel Corporation. Mr. Farrell talked from his office in New York City, and it was received by radio at the hotel. One of the interesting features of the opening was a demonstration of a minature electric locomotive that would start and stop when asked to do so. The locomotive was set up on a track in the hotel lobby and responded to the commands, "Go Ahead," "Stop," "Back Up," issued by Mr. Farrell from his New York office. The control for the locomotive is a product of the General Electric Company's research laboratories.

At the first technical session C. S. Proudfoot presided and called on S. S. Wales to present the report of his welding committee. This report was based on a questionnaire sent to the iron and steel industry asking information on the kind of welding equipment used, how it was used and to what extent. The report indicated that practically every type of welding is used in the iron and steel industry and that it is used for practically every purpose, from repair and construction work in power plants and mills to the manufacturing processes. The report and the discussion on it brought out that there are still large opportunities for extending the use of welding in the iron and steel industry.

An interesting feature of the first session was a paper on "Involute Gearing," by W. H. Himes and R. V. Baud. When presenting this paper, motion pictures were used to illustrate the generation of involute gearing and polarized light as a method of studying gear stresses.

At the Monday afternoon session C. L. Baker, chairman of the safety engineering division, presided. This meeting was devoted to the presentation of a paper, "The Incorporation of Safety into Electric Station Design," by V. R. Bacon. This paper was a comprehensive one, and covered safety in practically every part of power plant electrical design.

Safety a Fundamental of Design

"Safety," said Mr. Bacon, "for life, property and the continuity of service, should be a quality inherent in all electric structures, and, being a fundamental characteristic, can be engendered only as an element of design. Complete safety is unattainable; but this generality can never justify laxity when considering specific details. The degree to which safety should be incorporated must necessarily be tempered by the nature of the equipment, the importance of the installation, various local conditions and the funds available."

Emphasis was placed on the necessity of thorough correlation, for the promotion of general safety, between the building details and the location of electrical equipment. At the outset of the preliminary design the matter of fire and explosion hazards should receive detailed consideration. Such reflections usually indicate that inclosures containing large oil switches, transformers, storage batteries, etc., should be located outside the building and away from essential equipment. An arrangement of this kind is ideal, but is rarely ever accomplished, owing to justifiable economic reasons.

After outlining the fundamental principles of safety in design, Mr. Bacon discussed in detail how safety can be made a part of plant design, in reference to each class of electrical equipment. Most of the points considered were those that have come to light through experience in every-day design.

In the discussion on this paper it was brought out that there is a growing tendency toward the use of air-break instead of oil-break switches. For this reason it was recommended that the possibilities of using air-break instead of oil switches in plant design should always be carefully considered.

It was pointed out that many of the unsafe conditions that exist are due to losing sight of something that may happen in emergency. Attention was called to a recent case where a man was seriously shocked from a switch stick that had a carbon-tetrachloride fuse on it. The liquid from the fuse leaked out onto the wood handle and partly destroyed its insulating qualities. As a result, when a man tried to use the stick on a high-voltage line he was severely shocked. Tests made on switch

sticks by other operating companies have showed them to be faulty, and some companies are making it a practice to test all switch sticks before they are used.

The first session of the combustion engineering division was opened on Tuesday morning by Martin J. Conway, chairman of the division. Three papers were presented, the first, "Steam Generation and Utilization," by L. C. Edgar. After reviewing the advances that have been made to improve the efficiency of steam-generating and utilizating equipment, Mr. Edgar said:

Economy Improvements Without New Equipment

"Many of us are but spectators upon this great procession advancing in the interest of utilization of fuel, but are we to sit back and say, 'Unless there be some improvements in our plants and unless we be authorized to spend money for all these improvements, we can do nothing in the interest of fuel economy' —to which I reply, 'Positively, no.'

"There are many things that can be done in the interest of economy in the oldest plants. There is the waste that occurs in a multiplicity of items that grow up in every plant in spite of close supervision. We should tighten up on our supervision of these wasteful items, such as losses through lines, poor and improperly maintained traps on steam lines, and heating systems throughout plants, carelessness regarding the covering and re-covering of steam lines, etc. They are preventable losses, which can easily be corrected if we are alert to our responsibilities. There is the checking of the combustion of boilers, regardless of age and condition, that can be done and improvements made. There is the checking of air leaks, water leaks, steam leaks and countless other losses, which will, in the aggregate, amount to a surprising figure."

The discussion on Mr. Edgar's paper centered on the ways that steam consumption could be reduced around steel mills. It was the consensus of opinion that there were too many little services hooked up to the steam line. Many of these are used to heat out-of-the-way buildings or other places that no one pays much attention to. Consequently, the steam consumption for these services is high in proportion to what it should be. Attention was called to an instance where a large saving had been made in steam consumption by re-locating buildings required for sheltering employees and for other purposes. In addition, the employees were located more advantageously to their work.

Another instance of large savings made in steam consumption was on large blowing engines. The men in the engineering department put steam meters on the lines supplying the engines and each day rendered a report of the steam consumption to the department operating the engines. This got the department operators interested in keeping the engines in good condition, with a resultant large saving in steam.

In another case the installation of 81 steam-flow meters for metering the steam to each department resulted in improvements being made that allowed shutting down two coal-fired boiler plants and carrying the entire load on a blast-furnace gas-fired boiler plant.

R. E. Hall presented a paper entitled "Some Results of Boiler Water Conditions." Dr. Hall reviewed the development of boiler-feed-water treatment, outlined a method of conditioning (using phosphates), and called attention to examples of water conditioning.

In the paper, "Efficiency Versus Economy," H. G. Ebdon stressed the difficulties, when selecting equipment for a power station, of getting the results expected if this selection is based on manufacturers' guarantees alone. Mr. Ebdon based his remarks on the design of four boiler plants. There is a proper place for each of the different types of equipment, but it is quite a problem to work out the most suitable application, unless a competent consulting engineer is employed. In the opinion of Mr. Ebdon, some of the large manufacturers of equipment are in a position to make unbiased analyses of plant conditions as they are not limited to any particular type of fuel-burning or heat-absorbing equipment; and he believes the purchasers are beginning to take more advantage of this service.

Value of Gas as a Fuel

At the Wednesday morning session Walter N. Flanagan, chairman of the gas utilization committee, presented his report and said that the greatest development has been the increased realization of the value of gas as a fuel. The ease of control and the high efficiency readily attainable have led, first, to a series of campaigns to conserve gas, even to low-heating value blast-furnace gas, and, secondly, to the more extensive use of gaseous fuels.

As a part of the gas-utilization report, A. G. Witting presented a short paper on the "Value of Luminosity in Gas," J. C. Hayes a paper on "Foreign Practice and Some Examples of the Tendency Toward Conservation of Low-Grade and Waste Gases," J. W. Jones a paper on "Fuel for Continuous Normalizing Furnaces," and W. E. Bisler a paper on "Coke Dry-Quenching Practice."

Mr. Hayes called attention to the boiler plant recently put into operation at Alabama City by the Gulf States Steel Company. These boilers are fired with blast-furnace gas in combination with pulverized coal. The blast-furnace gas is delivered to the furnace at a temperature of 330 deg. F., and preheated air at over 600 degrees.

Mr. Bisler centered his discussion around coke plants that use an inert gas for quenching. In such plants after the inert gas passes through the hot coke it goes through a boiler where part of its heat is given up to make steam. A plant now being built at Flint, Mich., will have a capacity of 280 tons of coke daily and 280,000 lb. of steam at 100 deg. F. superheat.

A paper, "Combustion of Liquid Fuels," by R. C. Vroom described the different types of oil burners and discussed the factors that influence their operation. The conclusion is drawn that successful results from burning liquid fuel depend upon the installation and operation. The equipment should be installed and the fuel and air delivered to the burners under the conditions specified by the manufacturers. All the equipment should be kept clean and in operating condition. There is no reason why a plant burning liquid fuel should not be almost spotless. It is easy to burn liquid fuel economically with a little care and attention.

Economizers and Air Preheaters

"Economizers" was the title of a paper in which W. F. Keenan, Jr., discussed the use of economizers in combination with air preheaters. Some of the conclusions drawn were:

Where load factor, cost of fuel and other conditions justify only moderate recovery of heat from the boiler-exit gases, air heaters only should be used if it is known that preheated air is essential to good combustion results. Small economizers and small air heaters in combination will usually show better returns on the investment than either large air heaters or large economizers.

Other papers presented at the combustion engineering division sessions were: "Some of the Business Aspects of Furnace Manufacturers," by F. W. Manker; "Gas Producers," by F. E. Leahy, and "The Application of Pulverized Fuel to Industrial Furnaces," by W. O. Renkin.

The Placing of an Edison Generator in Operation in the plant of the Canada Cotton Company, of Cornwall, Ont., Feb. 28, 1883, resulted in the following editorial comment in a local newspaper (recently reprinted in the *Bulletin* of the Hydro-Electric Power Commission of Ontario) two days later:

"The new weave shed of the Canada Cotton Company was . . . lighted for the first time by the Edison Electric Light. It revealed, so we are informed, the objection which has in many instances been fatal to its success, and that is a too intense and flickering brilliancy. It has been established that the electric light when used in manufacturing establishments has produced all the most dangerous and afflicting forms of ophthalmia among the operatives. It may be that the light in the weave shed here possesses some exceptional charm—some soothing influence—for instance, a liberal commission. However, if it ultimately proves a success we shall be pleased to chronicle the fact, but in the meantime we agree with a leading English authority that electric light has had its day, and the fact that gas stocks are in no way affected by that light indicates that it is not regarded as a formidable rival."

To meet increasing demands, the installation was added to from time to time until there were six machines in line. However, the original generator was not discarded until 1913.

Heating Engineers Hold Record Meeting at Detroit

JUNE 11 to 13 inclusive and Hotel Statler, Detroit, were the time and place of one of the best annual conventions ever held by the National District Heating Association. Excellent committee reports compiled and pre-printed for the meeting, were interspersed with authoritative addresses dealing with late developments in the field. A registration approximating 200 was much better than average. The entertainment and the provisions made for inspection of engineering features were characteristic of Detroit Edison engineers, whose hospitality is so much appreciated that this convention had returned to the Motor City for the third time in twenty years.

The President's Address

At the opening business session, President John W. Meyer confined his address to the recording of several observations of significant importance to the heating field and the Association. Deep Water generating station, now in course of erection on the Delaware River 30 miles south of Philadelphia, he said marked the beginning of a change in the economic relations between electric utilities and those industries requiring large volumes of process steam. In addition to two 53,000-kw. turbine generators, it will be recalled that this station has a 12,500-kw. unit operating at 1,200 lb. pressure, which will exhaust all its steam through evaporators that in turn, will supply steam at 180 lb. pressure for process purposes to the Dupont Company nearby.

In 1927 six companies reported individually sales of steam in excess of one billion pounds. In 1928 seven companies so reported. As a measure of growth the speaker took the aggregate data of eight companies to show the gain of 1928 over the previous year. Sales increased 14.1 per cent; total customers, 26.6 per cent; net tons of coal burned, 1.15 per cent, and pounds of steam per customer, 4.1 per cent.

It was significant that an increase of 14.1 per cent in steam sold had called for an increase of only 1.15 per cent in coal. Looking at it another way, in 1927 the eight companies sold 12,087 lb. of steam per net ton of coal, or 6.04 lb. of steam per pound of coal. During 1928 the figures were 14,633 and 7.31, an increase of 21 per cent.

In a sense these figures were a measure of the effectiveness with which the work of the association had been applied. Greater skill had been and would continue to be exercised in the design, construction and operation of plants and distribution systems and in obtaining greater efficiency in metering and in utilization.

As a tribute to the man who had done much for central-station heating and had developed the second largest heating system in the world, Alexander Dow, president of the Detroit Edison Company, was awarded honorary membership in the association.

Of the various reports, that of the Station Operating Committee was of special interest, as it brought out a variety of contributions from nine representative companies in response to a questionnaire calling for definite information on the relationship of the steam heating and electrical departments, methods of determining size and location of plants, use of higher pressures, elimination of smoke, improvement of plant load factor, method of determining maximum plant load and the ratio of plant investment to income, to be accompanied by diagrams showing steam and water cycles and the heat flow. While some of the responses were rather meager, in the aggregate the nine reports were highly instructive on operating practice.

Operating Statistics

As has been the custom in years past the Committee on Operating Statistics collected a wide range of operating data from 38 companies, covering the boiler plant, economy of production, load factor, electric generation, fuel, labor, number of customers, etc. An innovation was the introduction of figures giving the estimated investment in the business as of Jan. 1, 1929.

This year the report of the Commercial Relations Committee was divided into four sections, as follows: Customer relations and service, effect of Detroit demand rate on recommendations to customers, study of a new heating survey code, and drawings of service and metering connections. An outline of the causes of waste in the use of steam followed in each case by the remedies recommended, was instructive. Considerable space was given to the new heat-loss survey code recently proposed to give a uniform basis for calculating heat losses from buildings. Comment was made on the work that had been done by the Heating and Piping Contractors National Association and the American Society of Heating and Ventilating Engineers. The committee believed that there was a great deal more work to be done before a better code could be produced. Continued co-operation with the other societies interested in the work was recommended. To improve the unsatisfactory conditions now existing, 26 drawings were reproduced showing typical connections for equipment on customers' premises, including meters, traps, economizers, water heaters, reducing valves and similar apparatus.

To obtain data on the operation and maintenance of hot-water heating systems, the Hot Water Committee had sent out inquiries to representative companies asking how to calculate the loss of circulating water from the system, how to detect and eliminate leaks, and what was the correct amount of water to circulate in a central plant heating system per hour, per square foot of radiation. Good constructive replies covering these points were received from Toledo, Ohio; Peru, Ind.; Terre Haute, Ind.; Maywood, Ill.; Oak Park, Ill., and Indianapolis, Ind. An interesting addition was a description by S. F. DeLany of the piping layout and results obtained in the new booster pumping station incorporated in the hot-water heating system of the Atlantic City Electric Company.

Two Papers on Welding

Two papers on welding featured the report of the Distribution Committee. J. F. Lincoln, of the Lincoln Electric Company, discussed electric arc welding of pipe in manufacture and in the field, and Glenn O. Carter, consulting engineer of the Linde Air Products Company, outlined the advantages of oxyacetylene welding, covering workmanship and materials, design of joint, qualifications of welder and testing. Discussion turning to the quality of metal in the weld, the advisability of annealing field joints, lapwelded vs. butt joints and the cutting of cast iron with a torch, indicated the lively interest that was taken in this subject.

A summary of data from various companies, giving their practice with respect to high steam velocities and the effect on pipe erosion, indicated that no concern need be felt in the design of any steam main for velocities up to 50,000 ft. per min. Other items included in the report were the installation and construction of large underground steam mains in Akron, Detroit and Philadelphia and a table giving the features of distribution systems in eighteen of the larger cities of the country.

The Meters and Accessories Committee gave much space to a discussion of the accuracy of steam-flow meters and some good general information pertaining to the volumetric method for testing condensation meters. A model operating schedule for the handling of customers' complaints was offered and there were simple reviews of accessories such as should be used in every good installation.

Supplementing the committee reports there were five addresses on subjects of current moment to the field. Prof. C. F. Hirshfeld, of the Detroit Edison Company, gave a stimulating talk on "Modern Industry, Its Development and Significance." We are just entering, the speaker said, an era where the steam distribution engineer would occupy an important place in future methods of power supply which modern industrial development is bringing about. With the perfection of power generating cycles involving higher steam pressures, the situation is rapidly changing, so that the correct solution of the economical supply of power and process steam to industry calls for cooperative effort among the power station engineer the steam distribution engineer and the industrial consumer, each a specialist in his line and all desiring to lower manufacturing costs.

Results of Tests

Prof. A. C. Willard, of the University of Illinois, drew from the results obtained in special test rooms at the Engineering Experiment Station at the University in showing the effects on steam consumption and the heating of a room introduced by the new types of radiator concealed in the building construction or inclosed by open grill work. Size of opening top and bottom for the passage of air, height of enclosure giving chimney effect, shields over the top, all had their influence, he said, and numerous charts were presented to show the effects on radiator condensation and the temperature gradient of the room. With these new types of radiator it was evident that other indices of performance in addition to pounds of steam condensed were essential.

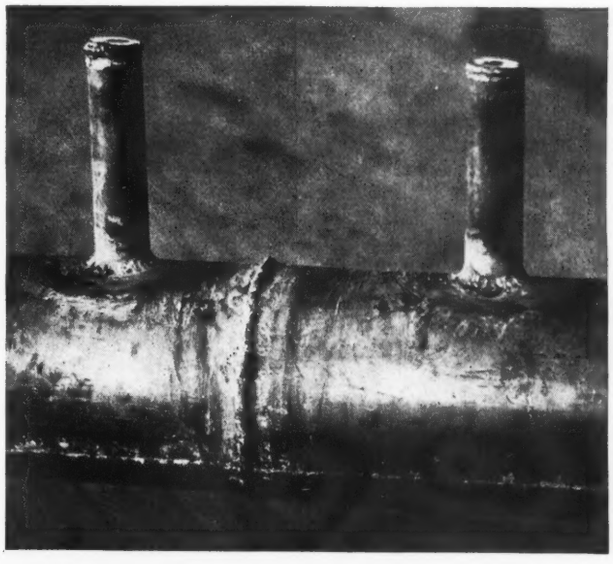
"Thermodynamics of District Heating Operations" was the subject of A. A. Potter, Dean of Engineering, Purdue University. Reviewing briefly the properties of steam and illustrating diagramatically the various steam cycles, the author showed the efficiencies that theoretically would be obtained in these cycles at the higher temperatures and pressures. From these curves it was evident that thermodynamic considerations justified electric power generation with the use of steam for district heating in a power plant using high-pressure steam. Such a high-pressure plant might be operated non-condensing during the heating season, or preferably bleeder turbines might be used and steam extracted for heating at practical pressures for different seasons. In many localities the electric station would do well to consider the generation of steam for district heating as well as for power production. If they can manufacture electricity cheaper than industrial plants, would not the use of higher-pressure steam enable them also to compete in the sale of steam? Practical considerations such as synchronism of heating and electric load factors, cost of fuel and distribution problems would determine finally the financial success of combining electric and district heating functions in one power plant.

Officers elected for the coming year are: President, J. C. Butler, Illinois Maintenance Company, Chicago; First vice-president, L. S. Smith, Rochester Gas & Electric Corporation, Rochester, N. Y.; Second vice-president, W. W. Stevenson, Allegheny County Steam Heating Company, Pittsburgh, Pa.; Third vice-president, A. D. Leach, Northwestern Electric Company, Portland, Ore.; secretary-treasurer, D. L. Gaskill, Greenville, Ohio; executive committee: E. E. Dubry, Detroit Edison Company; J. E. Seiter, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.; John W. Meyer, Philadelphia Electric Company.

Welding Monel Metal

SUCCESS in welding Monel metal requires a knowledge of the properties of this alloy and of its peculiarities under the welding flame.

Monel metal is an alloy of nickel and copper containing about 67 per cent nickel, 28 per cent copper, with 5 per cent of other elements such as iron, manganese, silicon and carbon. In appearance Monel metal, when new, resembles untarnished nickel. Probably its most valuable property is its resistance to corrosion.



Example of typical welded Monel header used in chemical plant

The following instructions for welding Monel metal have been released by the Linde Air Products Company. In welding Monel metal a few simple precautions must be observed. First, a neutral flame should be used. The tip should be one or two sizes larger than would be required for steel of the same thickness. Cold-drawn Monel-metal wire or strips, cut from sheet, should be used as welding rod. As a general rule flux is not required. The oxide film that forms on the surface of the puddle helps to protect the metal underneath from further oxidation. Keeping the outer envelope of the flame spread over the weld area will also aid in excluding air. The rod should be melted under this skin of oxide and slag. Any particles of dirt or foreign matter should be worked up into the slag by melting underneath them. Then, when the weld is built up well above the surface, as all Monel-metal welds should be, grinding will remove all oxide, slag and impurities, leaving only good sound metal in the weld.

Monel-metal castings present a peculiar combination of properties. Like gray cast iron, they are sensitive to sudden temperature changes while under the welding flame. Consequently, in welding such castings they must be carefully preheated, welded while hot and allowed to cool very slowly. Like cast aluminum, Monel castings have very little strength when hot, so the piece must be properly supported in the preheating furnace in order that the various parts of the casting may not collapse or distort under their own weight. The casting should be brought to an even dull-red heat of about 1,200 deg. F. and the temperature maintained as steady as possible during the welding.

When the weld is completed, cover all openings of the preheating furnace with asbestos paper, close the draft holes with sand and allow the casting to cool gradually in the dying fire. Do not uncover until the casting is stone cold. It is most important that the annealing process be carefully carried out as success depends to a large degree upon this factor.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Boulder Meeting Adjourns Without Agreement

ADJOURNMENT of the Tri-State Conference on the division of the lower basin waters of the Colorado River was taken recently without an agreement having been reached between Arizona, Nevada and California. Although it is still believed that Arizona will seek to determine her rights through Supreme Court action, the delegates seemed in closer accord at the end of the session than ever before. The Boulder Canyon act became effective the twenty-first of this month, and about a year's time probably will be taken in arranging contracts and other details preliminary to a work of such magnitude. By this time the Supreme Court could act and all legal difficulties presumably could be settled.

The conference was held to clear up some of the difficulties arising out of Arizona's opposition to the diversion of certain waters, so that the construction of Boulder Dam, authorized by the Johnson act, could go forward without hindrance. Discussion at the meeting hinged about the Gila River, which Arizona claims is not a part of the Colorado River system for purposes of the act because it joins the main stream close to the Mexican border below all contemplated diversions. Looking ahead fifty or a hundred years when the seven states are using their quota of allocated waters, if there is no surplus left for Mexico, some of the Mexican demand will have to be taken from the state apportionments. Arizona's contention is that to include the Gila in the system would deprive her of rights on the main stream if and when this shortage begins to be felt. In other words, Arizona claims exclusive right to the Gila and holds that such right shall not limit the share of water to be received from the Colorado River as divided in the agreement. It was suggested by Francis Wilson, of New Mexico, that such problems might well be deferred until they materialized, which might be never.

At the close of the conference Col. W. J. Donovan, chariman, submitted a simplified proposal for the state commissioners to consider before the next meeting. His statement reads: "The following formula is submitted not as a recommendation but simply as a suggestion which the states might accept as a basis in attempting to reach a conclusion. This formula is based on the principle that, as nearly as may be, the water of the Lower Basin shall be equally divided between Arizona and California. This principle must be kept in mind in considering the feasibility of this plan." Colonel Donovan's proposal is that:

"1. The Gila River shall go to Arizona.

"2. Arizona may use any of the unused waters of her tributaries other than the Gila, releasing therefor equivalent water from her main stream waters.

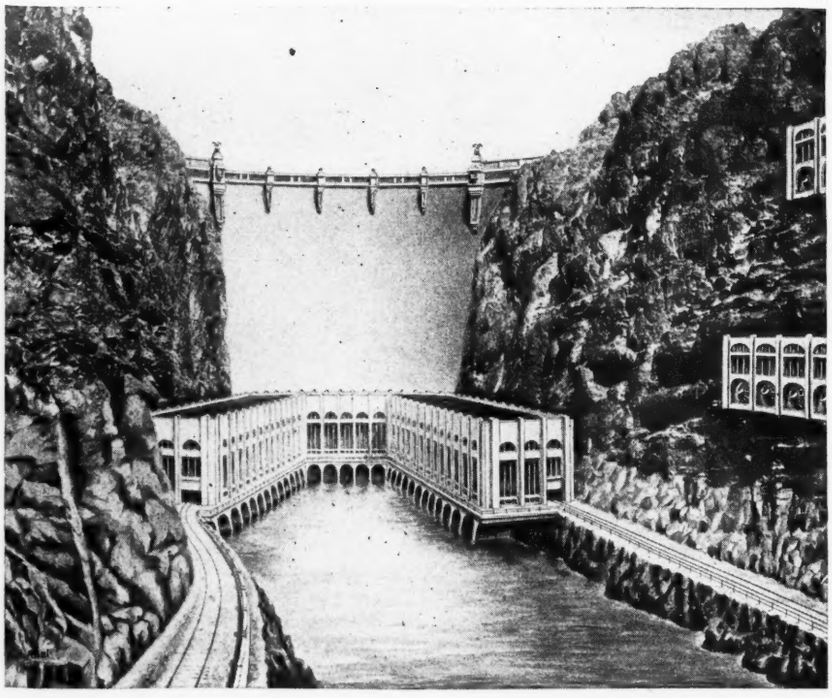
"3. Of the 7,500,000 acre-feet of water on the main stream apportioned to the Lower Basin by Paragraph a of Article III of the Colorado River Compact, 300,000 shall be apportioned to Nevada.

"4. Of the 7,200,000 acre-feet remaining and of the 1,000,000 acre-feet provided for in Paragraph b of Article III of the Colorado River Compact, Arizona and California shall each receive such a percentage as may seem fair and equitable.

"5. The additional available waters in the Lower Basin shall be divided equally between Arizona and California.

"6. The Mexican burden shall be borne equally by Arizona and California."

The next meeting of the conference will be held Oct. 14 in Santa Fe, New Mexico.



BOULDER Dam and power plant as they will look when completed according to present plans. This photograph is taken from a recent sketch made by the United States Bureau of Reclamation.

A.S.M.E. Meeting to Include National Parks Tour

Members of the American Society of Mechanical Engineers left New York City on June 17 for a tour of six national parks. They will visit Glacier, Yellowstone, Zion, Grand Canyon, Bryce Canyon and Rocky Mountain National Parks, stopping at Salt Lake City, Utah, July 1-4, for the semi-annual meeting of the Society. The entire trip will consume a month's time.

The semi-annual meeting will open on Monday, July 1, with headquarters at the Hotel Utah in Salt Lake City. Three technical papers of interest to power engineers will be presented at the opening technical sessions. They are: "The Development of Steam Turbine Oils," by A. J. Turner; "Modern Practice in the Installation and Starting of Hydro-Electric Units," by C. V. Foulds, and "Steam Distribution in a Beet Sugar Factory," by F. W. McEntire. Tuesday will be spent in the study and inspection of the Utah Copper Mine and Mills, with a formal banquet in the evening. At Wednesday's technical session, "The Fuel and Smoke Problem in Salt Lake City" will be outlined by G. A. Orrok and W. H. Trask, Jr.

Spot * News

IT IS NOT *within the authority of the Federal Power Commission to reject an application for power development on the ground that it may mar scenic beauty, is the opinion of the chief counsel of the Commission, recently made public in connection with the application for a license covering a project at Cumberland Falls, Ky.*

* * *

FAILING IN ITS *efforts to lease Muscle Shoals, the American Cynamid Company now plans to erect a $25,000,000 plant near Kingsport, Tenn., power for which will be supplied by a steam generating plant of huge capacity and three hydro-electric developments to cost $35,000,000 which are being projected by its subsidiary, the Holston River Power Company.*

* * *

THE CALIFORNIA *Railroad Commission decided June 17 that the prices San Francisco must pay for the electric systems of the Great Western Power Company and the Pacific Gas & Electric Company within the city as they existed on Feb. 11, 1924, are $11,815,000 and $26,685,000 respectively. These valuations are 25 per cent greater than the city offered and less than half of what the companies demanded.*

* * *

THOUGH NO SPECIFIC *agreement was reached at the recent oil conservation conference, the delegates unanimously adopted a resolution sponsored by the major oil producing states, Texas, Oklahoma and California, suggesting a further study of the problems and that the conference recess subject to future call by President Hoover.*

* * *

TO KEEP PACE *with the growing demand for metered steam and hot water in Akron, Ohio, the Northern Ohio Power & Light Company is constructing a $400,000 addition to its centralized steam plant.*

* * *

TO STUDY THE EFFECTS *of the legislative proposal of Senator Couzens of Michigan, with regard to regulation of communication by wire or wireless and interstate transmission of power, the American Engineering Council has appointed the following committee: E. F. Wendt, chairman; O. H. Caldwell; C. B. Hawley; Dexter S. Kimball; and Frank A. Scott.*

* * *

THE LARGEST ELECTRIC METER *in New York City was placed in operation recently by the New York Edison Company at the substation of the New York Central Railroad. This one meter replaces three which have been used to measure the high-tension energy supplied by three 11,000-volt feeders.*

Canadian Engineering Societies Are Fast Expanding

By Campbell Bradshaw,
Toronto, Canada

THAT Canada is no longer a barren field for association endeavor, at least so far as power-plant operators are concerned, is evident from the steady increase in recent months in both branches and members of the various organizations operating in the Dominion: The Universal Craftsmen's Council of Engineers, the Canadian Association of Stationary Engineers, the Engineers' Mutual Benefit Fund, the Montreal and District Engineers' Association, and the Western Association of Mechanical and Electrical Engineers—the first two with United States Affiliations, the others purely Canadian.

There are several good reasons for the expansion of the U.C.C. of E., the most effective probably the fact that when elected grand worthy chief of America at Milwaukee in 1927, Louis J. Cudbird, chief engineer, City Hall, Toronto, decided the election for the second time of a Canadian, Herb E. Terry to be the first so honored, to the highest office in the organization, made it an opportune time to wage a membership campaign in Montreal, hitherto a stronghold of the M.D.E.A. The status of the Montreal council today is ample proof of the wisdom of Mr. Cudbird's move. With two branches in Toronto, No. 27 and No. 52, the former with over 300 members, the U.C.C. of E. is also thriving in Hamilton, Winnipeg, Vancouver and Leamington, in addition to the council already mentioned in Montreal, its numerical strength far exceeding that of any other society in the field in Canada.

Although maintaining branches in two or three western Ontario towns, the activity of the C.A.S.E. elsewhere has been practically negligible until recently, since the formation of the E.M.B.F. in April, 1926, all of the Toronto officers of the older society, such as Robert McLaren, George A. Brown, F. A. W. Taylor, H. E. J. Groom, Campbell Bradshaw, and Thomas C. McAree, becoming directors of the new. A few months ago, however, one or two of the "old C.A.S.E. guard," including such "stalwarts" as Ed Golightly and John Quinlan, decided to resuscitate their first love. As a result, a quiet membership campaign was waged and enough support reported to ensure a self-sustaining branch.

With Tom McAree, head of the E.M.B.F., a successful year can be forecast, this society being the only one in the Dominion licensed to offer members funeral, sickness and destitution benefits, and for that matter, free medical attention to a limited extent to all members and their families in need of it. It is little wonder, then, that 300 power engineers, mechanical superintendents and maintenance men are to be found on the roster of Toronto No. 1, E.M.B.F. The principal officers for 1929 are: Tom McAree, Dominion president; F. A. W. Taylor, vice-president; George A. Brown, secretary; and Robert McLaren, treasurer, all of them "in harness" since the society's inception; in fact, the only change on the board during the year was the resignation of E. H. Perkins and the appointment of Gerald Huber in his stead. Since 1926 Mr. Huber has been financial secretary of Toronto No. 1.

It's the general belief in the capital of Quebec that to Henry Wright, more than any other one man, should be attributed the steady growth of the M.D.E.A., both in personnel and bank balance. Be that as it may, it is already apparent that there is room in the Dominion's largest city for both U.C.C. of E. and M.D.E.A., and at that both organizations have a long way to go to catch up with the Toronto bodies, although it must be admitted that so far, anything they lack in numbers they make up in enthusiasm and sociability—desirable attributes in any organization. Touching on the last of the Dominion's organizations, the W.A.M.E.E., in which membership is restricted to the West, and embraces to a greater extent than any of the other organizations the electrical field, steady progress can again be reported, from which it seems safe to conclude that the value of association endeavor is now fully recognized in Canada.

I.E.C. Meeting on Steam Turbines to Be Held in England

Meetings of the Advisory Committees on steam turbines and on the rating of electrical machinery of the International Electrotechnical Commission will be held in London, England, July 1-12. The British National Committee of the I.E.C. is acting as host to the delegates attending these meetings and has planned an interesting program of conferences and social gatherings. The steam turbine sessions will be held from July 1 to 6 at the Institution of Civil Engineers, and those of the rating of electrical machinery, from July 8 to 12. An informal luncheon at the Royal Automobile Club and a dinner to be given by the British committee, followed by a reception at the Natural History Museum, are features of the entertainment program.

The United States will be represented at these meetings by Dr. Wil-

liam F. Durand, professor emeritus of mechanical engineering at Stanford University; Francis Hodgkinson, consulting mechanical engineer for the the Westinghouse Electric & Manufacturing Company; Irving E. Moultrop, chief engineer of the Edison Electric Illuminating Company of Boston; and C. B. Le Page, assistant director of Secretariat, U. S. National Committee of the I.E.C.

Finland Inaugurates Large Hydro Station

In the presence of a distinguished gathering the great Imatra power station was recently opened by the President of the Finnish Republic. Imatra Falls are among the biggest rapids in Europe, and have long been a center of attraction for tourists. After much preliminary discussion of various schemes it was decided in 1921 to utilize the enormous power available in the Falls, and a project for this purpose was adopted.

The first stage has just been completed. The rapids have been dammed, and the natural height of fall, 62 ft., has thereby been raised to 75 ft. The power station has been constructed with three turbine units of 27,000 hp. each, making 81,000 hp. in all. It is expected that ultimately the total power derived from the Falls will be 216,000 hp. So far the cost has been about 320,000,000 Finnish marks, or, roughly speaking, $8,000,000.

The power station, which is located in eastern Finland, is connected with Helsingfors, the capital, and with Abo in the West by cables totalling 500 km. in length. A number of large consumers of electricity have already arranged to obtain their requirements from the Imatra power station, e. g., the towns of Abo, Wiborg, and also Helsingfors. Many important industrial undertakings in these different towns will obtain their supplies of power from Imatra.

N.A.P.E. Branches Hold Initiation Meetings

At a joint meeting of the Salt Lake City and Ogden (Utah) branches of the National Association of Power Engineers, held recently in Salt Lake City, thirteen new members were initiated into the national association. John Topham, of the Los Angeles association, and P. J. Buller, formerly of Salt Lake City, but now state deputy of California, had charge of the initiation ceremonies. The speakers included Mayor Frank Francis, of Ogden, one of the initiates; Mr. Topham, Mr. Buller, J. B. Critchlow, president of the Ogden association, and Lew Asher, state deputy for Utah.

A special meeting of the N.A.P.E. was held in Chattanooga, Tenn., recently for the purpose of initiating nine new members. Among those admitted were J. M. Lyle, chief engineer at the O. B. Andrews plant, and W. C. Kirk, superintendent of the Heron Metal Bed Company. Considerable time was spent at the meeting on discussions of the coming national convention and power show which will be held in Chattanooga from Sept. 9 to 13. The newly formed state association, consisting of the Knoxville, Nashville, Bristol, Kingsport and Chattanooga branches, has applied for a charter from the national organization and the first meeting will be held in Knoxville some time during the first part of July.

Men in the News

FRANK E. BONNER

of Piedmont, Calif., whose appointment as Executive Secretary of the Federal Power Commission to succeed O. C. Merrill, resigned, has just been confirmed by the Senate, comes to the Commission with twenty years of experience in government engineering work. For the last seven years he has been district engineer of the Forest Service in California, where his duties involved the supervision of several of the largest public-utility hydro-electric developments in the United States, including the construction of many dams of major size.

President Appoints Official Delegates to Tokyo

A delegation of seventeen has been appointed by President Hoover to represent the United States officially at the World Engineering Congress which will meet at Tokyo Oct. 29. Members of the delegation from Washington are Commissioner Elwood Mead, George Otis Smith, George K. Burgess, O. C. Merrill, Major-General Edgar Jadwin, Scott Turner and John Hays Hammond. From New York Elmer A. Sperry, Frank B. Jewett, John W. Lieb, Maurice Holland, Daniel L. Turner, Byron Eldred, J. V. W. Reynders and Mark Requa have been appointed. John R. Freeman, of Providence and Dugald C. Jackson, of Boston make up the list.

OBITUARY

CHARLES FRANCIS BRUSH, arc-lighting pioneer and founder of the Brush Electric Company, died on June 15 at his home in Cleveland from pneumonia. He was born in Euclid, Ohio, March 17, 1849.

After leaving the University of Michigan, from which he was graduated as a mining engineer at the age of twenty, Mr. Brush became interested in electrical experimentation. In 1876 he designed a dynamo that was exhibited at the Paris Exposition. Two years later he announced his plan of arc-lighting for streets, it being adopted immediately by the city of Cleveland. To him has been attributed the first use of iron laminations in generators, copper plating of carbon brushes, damper winding (in which a copper-band is used between the field magnets and surrounding coils) and compound winding, since widely employed on direct-current machines.

For his achievements in the field of electric lighting Mr. Brush was specially honored by many organizations and institutions. In 1913 the A.I.E.E. awarded him its Edison medal, and a year ago he received the Franklin Institute's Franklin medal. He was to have had a place of honor in the Cleveland celebration of "Light's Golden Jubilee." In addition to his affiliation with many other organizations, Mr. Brush was a member of the American Society of Mechanical Engineers.

A. DEL. NEAL, retired director of the Nason Manufacturing Company, died suddenly on June 4, at his home in Asbury Park, N. J. While connected with the Nason Company, of which he was secretary for many years, Mr. Neal was an outstanding figure in the steam specialties field.

PERSONALS

HERMAN TONNEMACHER, a director of the Siemens-Schuckertwerke, Germany, and general manager of its central-station department, has arrived in this country for a short visit. Herr Tonnemacher was active in the development of the high-pressure Siemens-Benson boiler.

JAMES H. MCGRAW, chairman of the board of the McGraw-Hill Publishing Company, received the honorary degree of doctor of commercial science from New York University at the commencement exercises held on June 12.

THOMAS M. GRAY, of Jersey City, was elected president of the New Jersey association of the National Association of Power Engineers at the organization's recent convention in Elizabeth,

N. J. John R. Rutherford, retiring president, was presented with a jeweled past-president's badge.

THOMAS W. MARTIN, president of the Southeastern Power & Light Company and the Alabama Power Company, has been elected president of the Commonwealth & Southern Corporation, a holding company for power and other public utilities securities.

JOHANN RUTHES, of Sweden, has been awarded the Wetherill medal by the Franklin Institute of Philadelphia, Pa., for economies made possible in steam production through his invention of equipment to store steam.

HERBERT SPEIGHT has been appointed section engineer in charge of electrochemical and electrometallurgical work in the general engineering department of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh, Pa. For many years Mr. Speight was engaged in the design and construction of power plants for mines.

ALLEN L. SNYDER, of New York City, has been appointed general manager of the $30,000,000 Osage River hydro-electric power plant to be erected by the Union Electric Light & Power Company. He will be in charge of the construction of the new plant at Bagnell, Mo., and also of the installation of two steel transmission lines to connect the plant with St. Louis.

BUSINESS NOTES

THE EDWARD VALVE & MANUFACTURING COMPANY announces the appointment of Frank W. Hoyt as its representative in the anthracite region, with offices in the Markle Bank Building, Hazleton, Pa.

YEOMANS BROTHERS COMPANY, of Chicago, has announced the appointment of the Capitol Equipment Company, Bank of Commerce Building, Charleston, W. Va., as its representative in the southwestern part of that state.

THE JEFFREY MANUFACTURING COMPANY of Columbus, Ohio, has appointed John L. Connors, for the last nine years president of the Morgan-Gardner Electric Company, assistant general manager.

THE AMERICAN HOIST & DERRICK COMPANY, of St. Paul, has moved its Chicago office to 205 West Wacker Drive and its Pittsburgh branch to the Farmers Bank Building.

THE LINDE AIR PRODUCTS COMPANY has opened two new oxygen-producing plants, one at 1000 West Washington Ave., Oklahoma City, Okla., and the other at 150 Stockton St., Jacksonville, Fla.

Coming Conventions

American Institute of Electrical Engineers. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, annual summer meeting, Bigwin Inn, Lake of Bays, Ontario, Can., June 26-28. A. V. Hutchinson, secretary, 29 W. 39th St., New York City.

American Society of Mechanical Engineers, spring meeting, Salt Lake City, Utah, July 1-4, 1929. Calvin Rice, secretary, 29 West 39th St., New York City.

American Welding Society. Fall meeting at Cleveland, Ohio, Sept. 9-13. Secretary, M. M. Kelly, 33 West 39th St., New York City.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

Northwest Electric Light and Power Association. 22nd Annual Convention, June 26-29, 1929, at Seattle, Wash. Registration and information: J. J. Hayes, Westinghouse Electric & Manufacturing Company, Seattle, Wash.

Universal Craftsmen Council of Engineers. Annual meeting in Detroit, Mich., Aug. 6-10, at the Book-Cadillac Hotel. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

TRADE CATALOGS

DIESEL ENGINES—A new line of small-capacity Diesels, ranging from 150 to 500 hp., has been brought out by Busch-Sulzer Brothers Diesel Engine Company, of St. Louis, Mo. The distinguishing feature of this type F engine, pictorially presented in a sixteen-page folder, is the employment of a cylinder block into which the levers are inserted and which bolts directly to the one-piece crankcase.

SWITCHING EQUIPMENT—The General Electric Company, of Schenectady, N. Y., has recently brought out a number of illustrated bulletins and leaflets pertaining to switches and switching equipment, including: 1029A, outdoor switching equipment, group-operated, rotating-insulator and disconnecting switches; 940A, switchboard devices, panel and benchboard fittings; 1109, automatic sectionalizing switches; 440A, type CL-1, turn-pull control switch; 1021A, type FK-33 oil circuit breakers; 163B, automatic switching equipment; 1096, type LG-18-B indoor disconnecting switch; 42A, induction power-directional relays; 138A type FR-1 current-limiting resistor, and type LA-1 current-limiting resistor-disconnecting switch.

WELDING—The wide range of uses of electric arc welding in the maintenance field is graphically portrayed in Bulletin DMF-5156, recently released by the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa., containing eight pages of pictures.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.35 @$2.40
Kanawha.....	Columbus.....	1.25 @ 1.50
Smokeless.....	Cincinnati.....	1.75 @ 2.00
Smokeless.....	Chicago.....	1.75 @ 2.25
S. E. Kentucky...	Chicago.....	1.35 @ 1.60
Steam.....	Pittsburgh.....	1.55 @ 1.65
Gas Slack.....	Pittsburgh.....	1.00 @ 1.15
Big Seam.....	Birmingham....	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.50@$2.75
Barley.....	New York.....	1.50

FUEL OIL

New York—June 20, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 5.25c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—June 12, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.40 per bbl. or 42 gal.; 26@28 deg., $1.45 per bbl.; 28@30 deg., $1.50 per bbl.; 30@32 deg., $1.55 per bbl.; 32@36 deg., gas oil, 4.3c. per gal.; 38@40 deg., distillate, 5.25c.

Pittsburgh—June 11, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.5c. per gal.

Philadelphia—June 11, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—June 11, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—June 15, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 60c. per bbl.; 26@30 deg., 72.5c. per bbl.; 30@32 deg., 95c. per bbl.

Boston—June 17, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.45c. per gal.; 28@32 deg., 5.5c. per gal.

Dallas—June 15, f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Newport Beach—City is having plans prepared for the construction of a sewage pumping plant, sewers, etc., in Lido Island Section. Estimated cost $1,000,000. R. L. Patterson is city engineer.

Conn., East Hampton—New England Water Light & Power Co., A. Lisle, 833 Hospital Trust Bldg., Providence, R. I., plans the construction of a hydro-electric power plant. Estimated cost to exceed $40,000. Private plans.

D. C., Washington — Quartermaster General's Office, D. Lynn, Capitol, Archt., will receive bids until June 27, for the construction of an annex to power plant building.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., awarded contract for masonry, etc. for a 35 x 159 ft. switch house at 1131-35 West 22nd St. Estimated cost $300,000.

Ind., Evansville — School Commissioners, awarded contract for the construction of a new power plant to Gottman & Weber, 23 Main St. Estimated cost $47,000. Two 250 hp. high pressure water tube boilers, new feed water heater and piping will be installed.

Ind., East Chicago — City is having preliminary plans prepared for extensions and improvements to light plant. Burns & McDonnell Engineering Co., 401 Interstate Bldg., Kansas City, Mo., is engineer.

Ind., Indianapolis—Indiana University Hospital, awarded contract for the construction of a hospital including power plant, boiler and turbine-generator unit, etc. to Krebay Construction Co., 802 New City Trust Bldg. Estimated cost $150,000.

Massachusetts—Edison Electric Illuminating Co., 39 Boylston St., Boston, will soon receive bids for the construction of a 50 x 160 ft. electric substation on Pond St., Woburn. Estimated cost $500,000. Bigelow, Wadsworth, Hubbard & Smith, 11 Beacon St., Boston, are architects. Whidden-Beekman Co., 250 Stuart St., Boston, are structural engineers. Plans also in progress for a power plant on Alford St., Charlestown. Private plans.

Mass., Attleboro—City, F. E. Briggs, Mayor, City Hall, is receiving bids for the construction of a pump house, wells, etc. J. J. Van Valkenburgh. Framingham, is engineer.

Mich., Plymouth—Detroit House of Correction, 1441 Alfred St., is having plans prepared for the construction of a prison institution including power house, etc. on Phoenix Rd. Estimated cost $1,250,000. A. Kahn, 1000 Marquette Bldg., Detroit, is architect.

N. H., Somersworth—Public Service Co. of New Hampshire and Central Maine Power Co., F. H. Mason, Ch. Engr., 9 Grange St., Augusta, Me., awarded contract for the construction of a water power station here, to Saunders Engineering Co., 102 Exchange St., Portland, Me.

N. J., Hackensack—Public Service Electric & Gas Co., 80 Park Pl., Newark, will build an electric distribution plant on Newman St. Estimated cost $250,000. Public Service Production Co., 80 Park Pl., Newark, is architect.

N. J., Jersey City—P. Simone & Co., Inc., 22 Journal Sq., Archts. and Engrs., will receive bids about July 15 for the construction of boiler room, power house and tunnel, for Brunswick Laundry, 222 Tonnele Ave. Estimated cost $160,000.

N. Y., Buffalo—Bd. of Managers, Buffalo City Hospital, will receive bids until July 9 for the construction of a group of hospital buildings including power plant, etc. at 462 Grider St. F. J. & W. A. Kidd, 524 Franklin St., are architects.

N. Y., New York—Kenn-Well Contracting Co., 45 East 17th St., awarded sub-contracts for steam power plant at 701 East 14th St. for New York Edison Co., 130 East 15th St.

N. Y., New York—New York Central R.R., 466 Lexington Ave., awarded contract for the construction of a 7 story, 200 x 200 ft. garage, service station and boiler house at West End Ave. between 65th and 66th St., to Turner Construction Co., Graybar Bldg. F. B. Freeman is chief engineer.

N. Y., New York—New York Steam Corp., D. C. Johnson, Pres., plans a 117 x 178 ft. addition to steam generating plant at Water and Pearl Sts. Estimated cost $250,000. Private plans.

N. Y., Thiells — Dept. of Mental Hygiene, Albany, awarded contract for addition to power plant at Letchworth Village, here to Ascher Engineering & Contracting Co., 1457 Broadway, New York. Estimated cost $100,000.

O., Cleveland—City, D. S. Blossom, Dir., received lowest bid for the construction of a 40 x 82 ft. boiler house at Hudson Farm from Burt Shields Co., Citizens Bldg. Estimated cost $60,000.

Utah, Mount Pleasant—City plans an election to vote $30,000 for the construction of a hydro-electric plant, 175 kva. capacity.

Ont., Hamilton—McMaster University, H. P. Whidden, 273 Bloor St. W., Toronto, awarded contract for the construction of a group of college buildings including heating plant, etc. on Westdale St. here, to Piggott Construction Co., Piggott Bldg., Hamilton. Estimated cost $1,500,000.

Que., Riviere du Loup—Municipal Council, plans the construction of a new power house. G. Quimet is engineer.

Equipment Wanted

Air Compressor, Pumps, etc.—City of New Ulm, Minn., will receive bids until June 28, for air compressors, pumps, etc., for proposed waterworks improvements. Estimated cost $120,000.

Boilers, Coal Handling Equipment, etc.—City of Springfield, Ill., will receive bids until July 8, for new boilers, coal and ash handling equipment, etc. on Sanamon River. Estimated cost $100,000.

Boilers, Pumps, etc. — City of Greensburg, Ind., will receive bids until July 1, for two 150 hp. boilers, one vacuum and one boiler feed pumps, for proposed power house. Estimated cost $100,000.

Boilers, Stokers, Etc.—Bd. of Managers, South Dakota Soldiers Home, I. L. Adams, Secy., Pierre, S. D., will receive bids until July 3 for boilers, stokers, etc. for proposed boiler house.

Boilers, Stokers, Turbines, Condensers, etc.—Nebraska State University, Lincoln, Neb., will receive bids until July 1, for three 800 hp. boilers, two stokers, two 1,500 kw. turbines and condensers, coal handling equipment, cooling tower and switchboard for proposed improvements to heating and power plant.

Conveyors—MacDonald Engineering Co. Ltd., R. Shoemaker, Supt., Sorel, Que., is in the market for two 42 in. and four 48 in. belt conveyors, etc.

Engine, Power Plant Equipment—City of Burlington, Ill., new Diesel oil engine, power plant equipment, etc. for proposed waterworks improvements. Estimated cost $300,000.

Engine Power Plant Equipment — City of East Chicago, Ind., plans the installation of a Diesel oil engine, power plant equipment, etc., for proposed waterworks.

Generator Unit—Byllesby Engineering & Management Corp., 231 South La Salle St., Chicago, Ill., plans the installation of a 750 kw. generator in power plant at Shattuck, Okla. Estimated cost $25,000.

Pumping Unit—City of Holtville, Calif., E. M. Carpenter, Clk., will receive bids until July 26, for a 1,200 g.p.m. pumping unit with motor, etc. for proposed waterworks improvements.

Pumping Units—City of Toronto, Ont., S. McBride, City Hall, Mayor, will receive bids until July 2, for two electric portable centrifugal pumping units.

Pumps, etc.—Bd. of Public Affairs, G. Urban, Clk., St. Paris, Ohio, pumps, etc. for proposed waterworks improvements. Estimated cost $60,000.

Pumps, etc. — California Water Service Co., Hunter-Dulin Bldg., San Francisco, Calif., pumps, etc., for proposed waterworks system to serve towns of Martinez, Concord, Crockett and Port Costa.

Pumps, Etc.—City of Salinas, Calif., M. R. Keef, Clk., will receive bids until July 1 for nine two port closed impeller horizontal sewage pumps, 50 to 500 g.p.m. capacity; two horizontal centrifugal pumps, with variable speed motors, 100 g.p.m.; one deep well turbine pump, 100 g.p.m., for proposed sewage pumping stations.

Pumps, Etc.—City of Poplar Bluff, Mo., will will receive bids about July 15 for one 700 and one 1,400 g.p.m. low head motor driven pumps, two 1,000 g.p.m. high service pumps, motor and steam driven, 5,000 g.p.m. wash pump, etc. for proposed waterworks. Estimated cost $100,000.

Pumps and Motors—City of Maud, Okla., G. Ingle, Clk., will receive bids until July 3, for two deep well pumps and motors for proposed waterworks improvements. Estimated cost $28,000.

Substation Equipment — Mineral County Power System, Hawthorne, Nev., will receive bids until July 7 for electric substation equipment including 33 kv. metering equipment connected Delta-Star 3 ph. 3 wire primary and 3 ph. 4 wire secondary with neutral wire on Star hookup to give 2,300 v. from 4,000 v. secondary metered on high side of transformers, 33,000 Delta 57,000 Star. To be of outdoor type, oil insulated combined potential and current transformers, with weather-proof box in which there must be installed demand meter and check meter.

Transformers, Switchboards, etc. — Toronto Hydro Electric Commission, 226 Yonge St., Toronto, Ont., equipment including bus bars, switchboards, meters, relays, circuit breakers, oil switches, insulators, transformers, cable, switches, etc. for proposed sub-stations, two on Yonge St. near Blythwood Rd. and one on Queen St. E. Estimated total cost $1,700,000.

Industrial Projects

Calif., San Francisco—INK FACTORY—California Ink Co., 426 Battery St., awarded contract for the construction of an 8 story factory at Sansome and Merchant Sts. to Barrett & Hilp, 918 Harrison St. Estimated cost $400,000.

Calif., Torrance — CEMENT PLANT — Paramount Portland Cement Co., 2030 Wilshire Blvd., Los Angeles, Calif., awarded contract for the construction of a cement plant including packing house, machine shop, etc. here to H. H. Helbush & Co., 2030 Wilshire Blvd.

Conn., Elmwood (Hartford P. O.)—FACTORY—Wiremold Co., 410 Asylum St., Hartford, awarded contract for a 2 story, 98 x 200 ft. factory to Bartlett & Brainerd Co., 252 Asylum St., Hartford. Estimated cost $175,000.

Conn., Waterbury—CLOCK FACTORY—Lux Clock Co., 97 Sperry St., will receive bids until July 1 (extended date) for a 4 story, 45 x 150 ft. factory on Johnson St. Estimated cost $150,000. T. M. Freney, 51 Leavenworth St., is architect.

Ind., Indianapolis—BOX FACTORY—U. S. Corrugated Box Co., H. J. Lacey, Pres., 1315 Martindale Ave., is having plans prepared for the construction of a factory at Martindale and Roosevelt Aves. Estimated cost $200,000. C. E. Bacon, Odd Fellows Bldg., is architect.

Ky., Louisville—CIGAR FACTORY—American Cigar Co., 111 5th Ave., New York, N. Y., is having plans prepared for a 5 story, 167 x 400 ft. factory at 13th and Vermont Sts. Estimated cost $2,500,000. J. Weis,, c/o. owner, is architect.

Mass., Holyoke—PAPER MANUFACTURING PLANT—Chemical Paper Co., R. Bosworth is receiving bids for a 2 story, 60 x 215 and 60 x 107 ft. factory on Jackson St. Estimated cost $175,000. Private plans.

Mich., Battle Creek — FOOD PRODUCTS PLANT — W. K. Kellogg Co., 246 Champion St., plans the construction of a 5 story, 100 x 350 ft. food products factory on Stoles St. Estimated cost $750,000. Architect not announced.

Mich., Hamtramck—PORCELAIN FACTORY—Champion Porcelain Co., 4525 Butler Ave., awarded contract for the construction of a 1 story, 80 x 235 ft. factory to C. O. Barton Co., 1900 East Jefferson Ave., Detroit. Estimated cost $50,000.

N. J., Newark — WIRE FACTORY — Gilby Wire Co., W. B. Driver, Pres., 123 Jackson Ave., awarded contract for a 1 story, 90 x 160 and 28 x 50 ft. additions to factory for the manufacture of wire and tubing for radios to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $100,000.

O., Cleveland—STEEL PRODUCTS FACTORY—Midland Steel Products Co., E. J. Kulas, Pres., West 106th St. and Madison Ave., awarded contract for a 1 story, 96 x 116 ft. factory including loading platform, etc., to W. F. Hendrich Co., 2777 East 53rd St. Estimated cost $70,000.

O., Columbus—OILCLOTH FACTORY—Columbus Union Oilcloth Co., H. E. Nesbitt, V. Pres., awarded contract for a 1 and 2 story, 200 x 200 ft. factory on 7th Ave. to M. J. Delaney, 187 Seymour St. Estimated cost $100,000.

O., Toledo—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., plans the construction of a plant here. Estimated cost $150,000. Private plans.

Pa., Pittsburgh — PRINTING MACHINERY FACTORY — Miller Printing Machinery Co., N. S. awarded contract for a 1 and 2 story, 56 x 180 ft. addition to factory on Reedsdale St. to D. T. Riffle, 1007 Forbes St. Estimated cost $50,000.

Ont., Toronto—PHYSICIANS SUPPLY FACTORY—F. J. Hartz Co., Ltd., 24 Hayter St., awarded contract for a 6 story factory, etc. for the manufacture of physicians supplies on Grenville St. Estimated cost $200,000.

POWER

With which are consolidated *The Engineer* and the *Stationary Engineer*

Volume 69 Number 26

June 25, 1929

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CHANGE OF ADDRESS

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Member Associated Business Papers.

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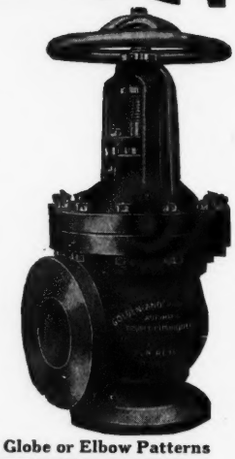
AUTOMATIC GOLDEN-ANDERSON CUSHIONED

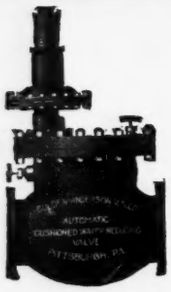
Triple Acting, Also Non-Return Valves

1. Automatically cut out the boiler the instant that a tube rupture or other internal break occurs.
2. Automatically cut off the steam flow from every boiler the instant that a steam pipe breaks.
3. Automatically equalize the pressure between all boilers.
4. Automatically cut in a boiler making accidents due to inaccurate steam gauge impossible.
5. Positively prevent backflow of steam into a cold boiler.
6. Can be closed by hand, like ordinary stop valve, and arranged with "combination feature" to open valve like regular gate and globe valve.
7. Can be tested in service from boiler room floor.
8. Double Corliss Dash Pot that cushions in opening and closing. As they are sealed and out of current steam flow, dirt and grit cannot bind or stick valves.
9. Cannot pound, spin, stick or chatter.
10. By disconnecting pilot valve, the triple-acting style can be changed into plain non-return.



Angle Globe or Elbow Patterns

Pat. Automatic Cushioned Water Pressure Regulating Valves



1. Maintain a constant reduced pressure regardless of fluctuations on high pressure side.
2. Perfectly Cushioned by water and air. No metal-to-metal seats.
3. The best valve made for maintaining a constant low pressure where consumption is continuous.
4. Operates quickly or slowly as required — No attention necessary.
5. Positively no hammering or sticking. Sizes to 24 in.

Heaviest Valves Made

GOLDEN-ANDERSON

Cushioned Patented Automatic Altitude Valves

For Automatically maintaining Uniform Stage of Water in Tank, Reservoir or Standpipes. Doing away with the annoyance of Freezing and Float Fixtures inside or outside of Tanks. "Three Ways of Closing these Valves."

1st—Automatically, by Water.
2nd—By Electricity, if desired.
3rd—By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe.

No Valves or Fixtures Inside or Outside.

"Made with stop starter attachment for centrifugal pumps."

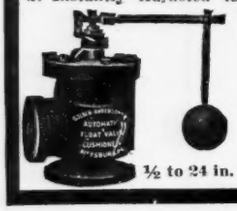
Sizes to 24 in.

Pat. Automatic Cushioned Steam Pressure Reducing Valves

1. Maintain a constant reduced pressure.
2. Thoroughly cushioned.
3. No hammering, chattering or sticking.
4. No auxiliary valve or small by-passes to clog up.
5. No wire drawing.
6. Only one adjustment from the outside.
7. Double extra heavy throughout — practically indestructible.

Pat. Automatic Cushioned Water Float Valves

1. Automatically Maintain Uniform Water Levels in Tanks, Standpipes, etc.
2. Instantly Adjusted to Operate Quickly or slowly.
3. Floats Swivel to any Angle—Most Satisfactory Float valves Known.
4. No Metal-to-Metal Seats — No Water Hammer or Shock.
5. Cushioned by water and Air.



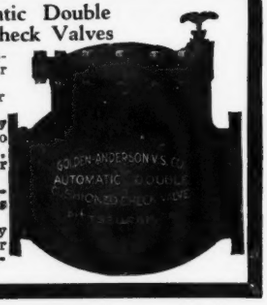
½ to 24 in.

Pat. Automatic Cushioned Controlling Float Valve

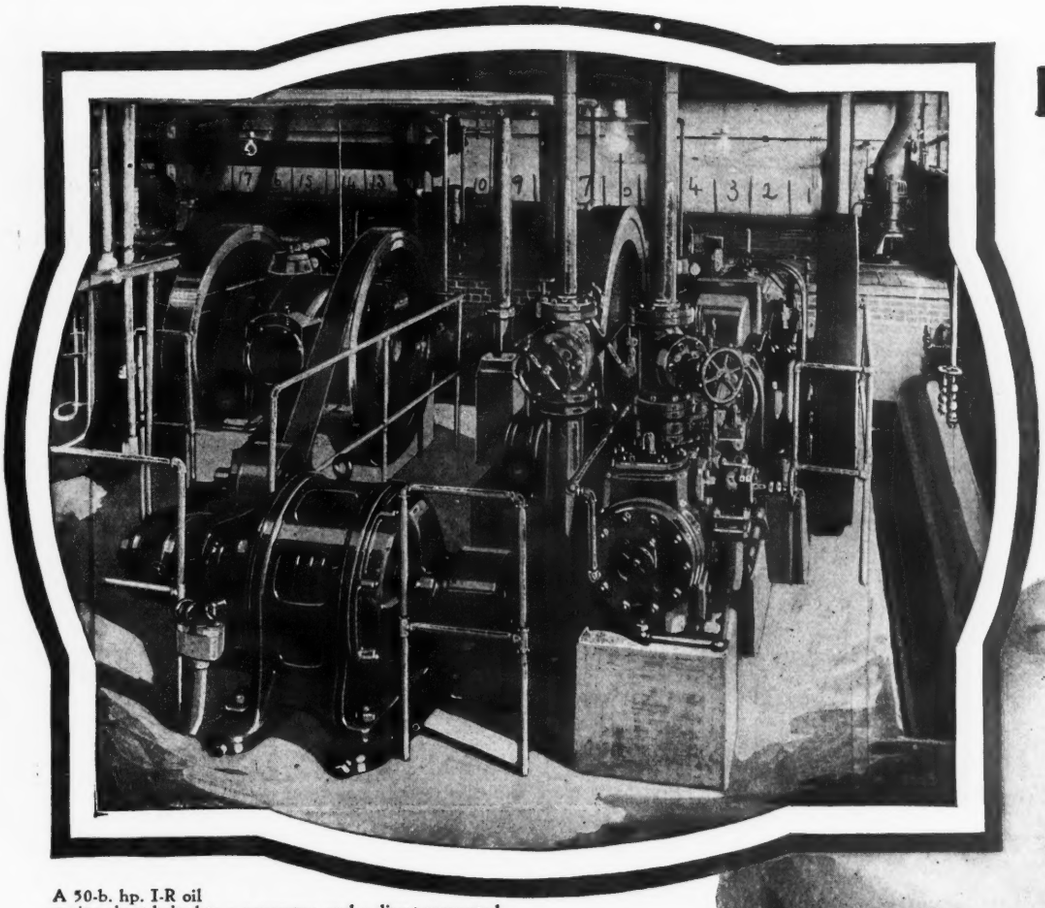
1. Automatically maintains uniform level in heaters, tanks, etc.
2. Air and water cushioned.
3. No metal-to-metal seats.
4. No waste of water.
5. No water hammer or shock.
6. Angle or Globe patterns to 24 in.

Pat. Automatic Double Cushioned Check Valves

1. Especially adapted for Water Service.
2. For High or Low Pressure.
3. Thoroughly Cushioned. No Chattering, Hammering, or Sticking.
4. Globe or Angle Patterns up to 24 in.
5. Especially adapted for hydraulic elevator service.



Golden-Anderson Valve Specialty Co., 1317 Fulton Bldg., Pittsburgh, Pa.



A 50-b. hp. I-R oil engine short belted to a generator, and a direct-connected, oil-engine-driven ammonia compressor installed in a New Jersey ice and cold storage plant.

ECONOMY

In many plants, Ingersoll-Rand oil-engine-driven ammonia compressors are making ice at a fuel cost of only 25 cents per ton. These records are by no means exceptional.

How do *your* fuel costs compare with this figure?

INGERSOLL-RAND CO. - 11 Broadway - New York
Branches or distributors in principal cities the world over
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10 Phillips Square, Montreal, Quebec

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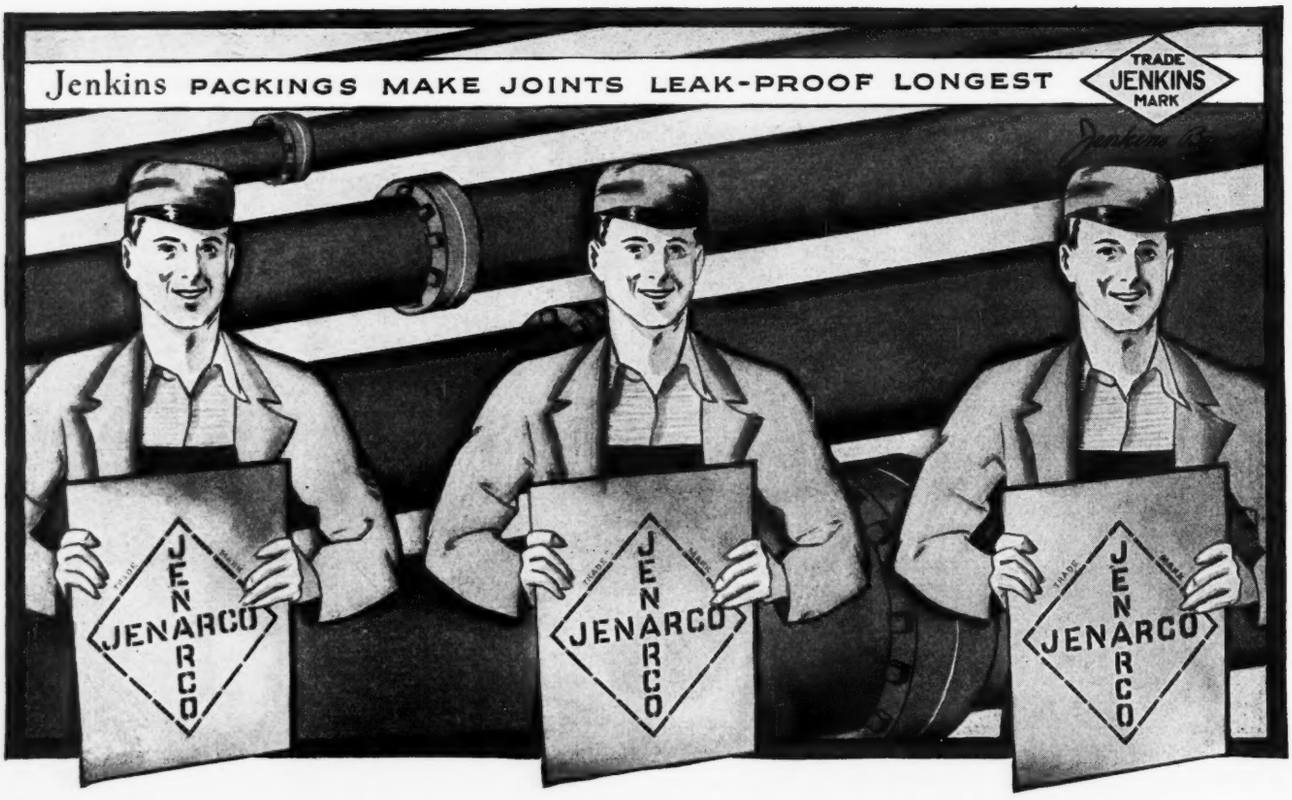
53-AC

R-870



Pack up your troubles with Jenarco —*and smile, smile, smile*

To the engineer with Jenarco Packing in his "old kit bag" the ancient song takes on a modern meaning.

Because with this red rubber sheet packing, it's an easy matter to pack a joint that stays packed, whether the line carries saturated steam at all pressures or hot or cold water.

Jenarco is a packing guaranteed by Jenkins Bros., made to the same high standards which have distinguished the manufacture of Jenkins Valves over a period of 65 years.

Jenarco is but one of several brands of Jenkins Packings which are available in sheets or in ready cut gaskets. Booklet 3a gives further data on the different brands and the services for which each Jenkins Packing is recommended; let us send you a copy.

JENKINS BROS.

80 White Street, New York, N.Y. — 133 No. Seventh Street, Philadelphia, Pa.
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Jenkins
PACKINGS

HENRY LAUNDRY CO.
CLEANERS and DYERS
FINE AND MAPLE STREETS

LADIES AND GENTS GARMENTS PRESSED AND REPAIRED

Hazleton, Pa., Feb. 13, 1929

Northern Equipment Company, Erie, Pennsylvania.

Subject: Copes Feed Water Regulators

Gentlemen:

You asked for my opinion on Copes Feed Water Regulators.

In 1909, as Chief Engineer for Jacob Gerhardt & Company, I supervised the installation of a Copes Regulator on a 120 H.P. Bigelow Boiler in that plant. This regulator was in constant service until December 1917, when our plant was wiped out by fire. During that time--almost nine years-- the Copes gave close, effective regulation over the amount of water fed to the boilers, and, as I recall it, the maintenance cost was very low.

After the fire, the plant was rebuilt and a new 150 H.P. Bigelow Boiler erected. The contract covered another make of feed water regulator, but this one was scrapped after about a year's service. In January, 1923, we installed a Copes Regulator on this boiler. It paid for itself in a short time and is still giving splendid service.

In December, 1927, Jacob Gerhardt & Company went out of business and the property was taken over by Henry Laundry Co., I stayed with the plant as Chief Engineer. In May, 1928, we added another Bigelow Boiler and equipped it with a Copes Regulator. This regulator also paid for itself in a few months.

Considering the factors of safety and savings in fuel and time, I consider Copes Regulators the most profitable investment we have made.

Very truly yours,

HC:W

HENRY LAUNDRY COMPANY.

Harry R. Curtis

Chief Engineer.

FOR SMALL BOILERS

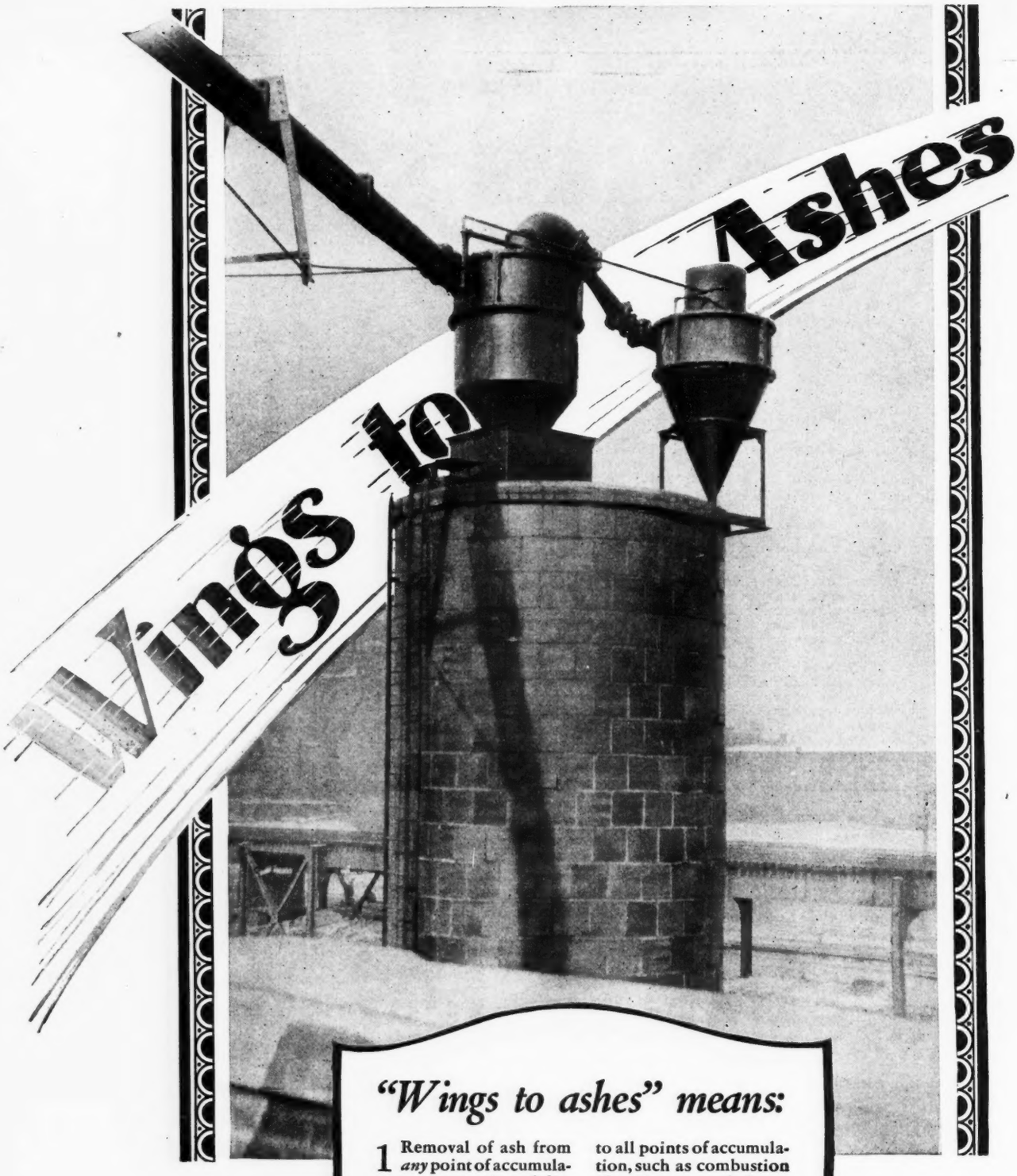
With all the talk about splendid performance of COPES on high-pressure boilers,* it is well to remember that COPES performs equally well on any make or type of boiler — regardless of size or drum pressure. Write for the booklet, COPES Feed Water Regulators.

NORTHERN EQUIPMENT COMPANY
641 Grove Drive, Erie, Pa.

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY, AUSTRIA AND ITALY. REPRESENTATIVES EVERYWHERE.

COPES
SYSTEM OF BOILER FEED CONTROL

* You knew that Stone & Webster, Inc., had ordered COPES Regulators for additional 1400-pound pressure boilers at Edgar Station, after COPES had proved its superiority on the first 1400-pressure boilers at that plant. And the Masonite Corporation has ordered two COPES for the new 1200-pound pressure boilers at their Laurel, Mississippi, plant.



"Wings to ashes" means:

1 Removal of ash from *any* point of accumulation to *any* point of disposal in a *single* operation.

2 Lower operating cost.

3 Dustless and silent operation.

4 *Flexibility* of the Conveyor *pipe* line permits low cost extensions to all points of accumulation, such as combustion chambers, stack base, main ash pits, etc.

5 Remote Control (Push Button Switch) at *each* feeding point.

6 Ash deposited *dry* in storage bin,—no freezing,—always free gravity discharge from bin.

Compare the Nuveyor

with any other ash handling system selling at any price!

THAT is a rather sweeping statement, particularly in view of the fact that a Nuveyor installation represents only a moderate outlay. But actual results have shown that this pneumatic conveyor actually sums up the good points of *all types* of conveyors and at the same time removes the objectionable features of other systems.

Compare the Nuveyor with steam jet ash conveyors: It has the same pipe line flexibility of installation, but the terrific sand blast effect, and the noise and high maintenance are eliminated. Moreover, only a fraction of the steam is required.

Or compare it with other pneumatic systems: It has the same smooth operation, but the air tight storage tank with its air leakage and explosion hazard is eliminated. In fact, a storage tank is not essential with the Nuveyor.

Even expensive sluicing systems are no more efficient or positive than the Nuveyor, yet, unlike sluicing systems, the Nuveyor delivers *dry* ashes, an essential feature where freezing temperatures are encountered.

To appreciate the Nuveyor you must see it in action. Then you will know how smoothly the ashes or other conveyed material are pulled through the pipe with minimum wear. You will also see how perfectly the dust is separated from the ashes.

By eliminating all sources of air leakage in the pipe line, combined with an efficiently designed multi-jet exhauster, steam consumption has been greatly reduced as proved by actual operating records.

Adaptable to existing Steam Jet Ash Conveyors

The Nuveyor is the product of eighteen years of experience in the designing and building of ash handling equipment. Before its introduction it was subjected to most exhaustive field tests, and in actual practice it has more than exceeded the highest expectations of its designers. While the ideal system is a *complete* Nuveyor system, the Nuveyor units are also adaptable to your present steam-jet ash conveyor. Let us show you how we can modernize this vital part of your plant. Send coupon for the facts.

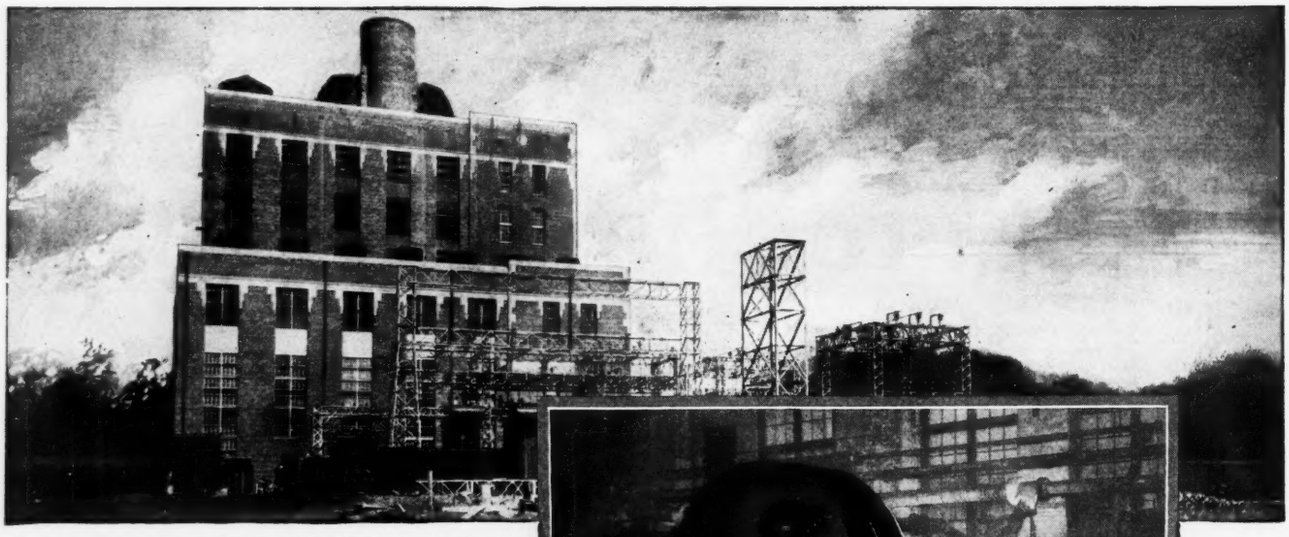
UNITED CONVEYOR CORPORATION
OLD COLONY BUILDING, CHICAGO
Branches in Principal Cities

United Conveyor Corporation

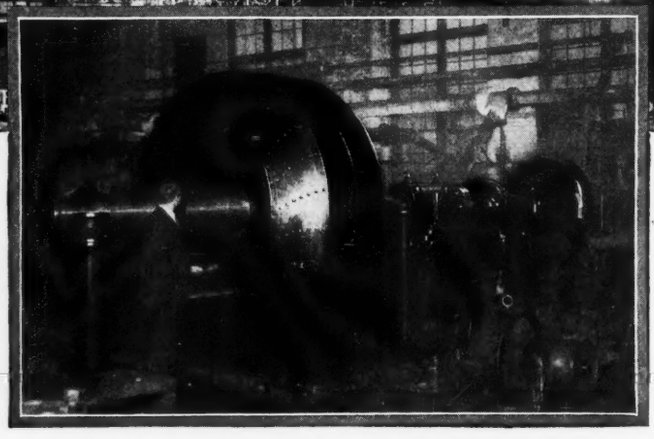
NUVEYOR

the pneumatic UCC "TALK YOUR ASH TYPE—YOU WANT THEM" *ash conveyor*

United Conveyor Corporation,
Old Colony Bldg., Chicago.
Please send facts about the Nuveyor
Company Name
Street and Number
City and State



New Gorgas Station built by the Dixie Construction Co.



a New World's Champion . . . !

. . . this is the most powerful induced draft fan ever built

—operating at 18″ static pressure—22,500 feet per minute rim speed—requiring an 1800 H. P. motor to drive it.

It is a Sturtevant "Turbovane" with *vane control* designed for the Alabama Power Company, Birmingham, Ala., for its New Gorgas Station at High Level, Ala. Variations in volume and pressure are controlled by movable vanes located in the spiral inlet boxes.

It's a world champion on speed too . . . the 98 inch wheel has a rim speed of 22,500 feet per minute . . . over 250 miles per hour! The stresses are tremendous. Only the most exacting selection of alloy steel, and long experience with the most modern equipment for heat treatment can put *reliability* into a fan of this character. Every joint is hand riveted as painstakingly as the finest craftsmen can do it. Welding is *not* used on "Turbovane" wheels!

Equal care is used in both static and running balances. The illustration above shows this fan with its own shaft and bearing receiving its running balance on our test plate. .

It would be a pleasure for our nearest branch office to send you our latest Turbovane catalog or give information on this new vane controlled fan which is proving so popular with power station designers.

B. F. STURTEVANT COMPANY

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STEAM TURBINES ~ FORCED AND INDUCED DRAFT FANS ~ ELECTRIC MOTORS
FUEL ECONOMIZERS ~ GENERATING SETS ~ AIR PREHEATERS

HELL GATE

largest steam generating central station in the United States...always a user of "S-C" Feed Water Regulators.

In 1921, Hell Gate Station went into operation with "S-C" Feed Water Regulators controlling the boiler water input.

1929 . . . and, with many extensions, this station takes rank as the largest steam generating station in the United States.

Each step toward this goal . . . each new boiler has brought additional installations of "S-C" Regulators. Hell Gate, from its first day in operation, has always been an "S-C" user.

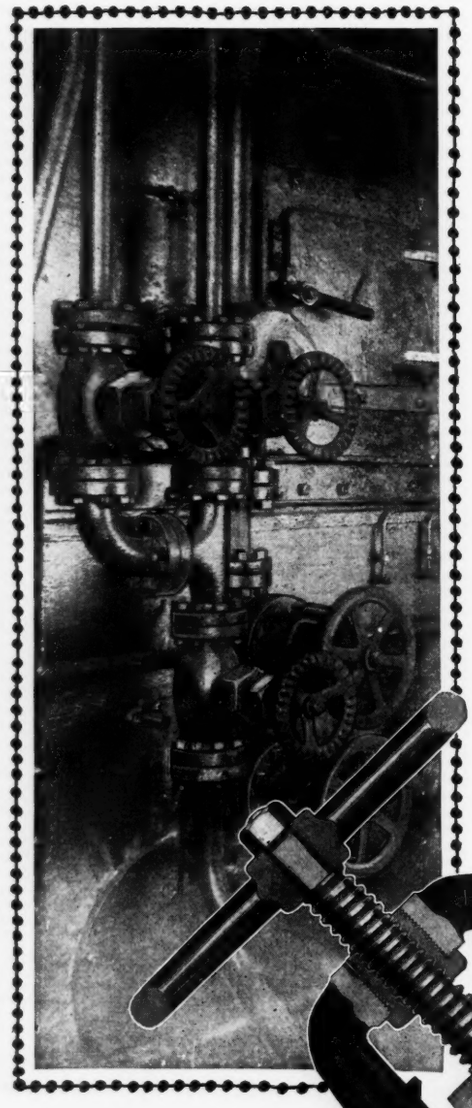
THE SWARTWOUT COMPANY

18511 Euclid Avenue , Cleveland, Ohio

Swartwout Power Plant Equipment

Feed Water Regulators . . . Pressure Valves . . . Pump Governors . . . Vacuum Governors . . . Master Controls . . . Reducing Valves . . . Relief Valves . . . Drainage Controls . . . Traps . . . Separators . . . Exhaust Heads . . . Desuperheater Governors . . . Feed Water Heaters.

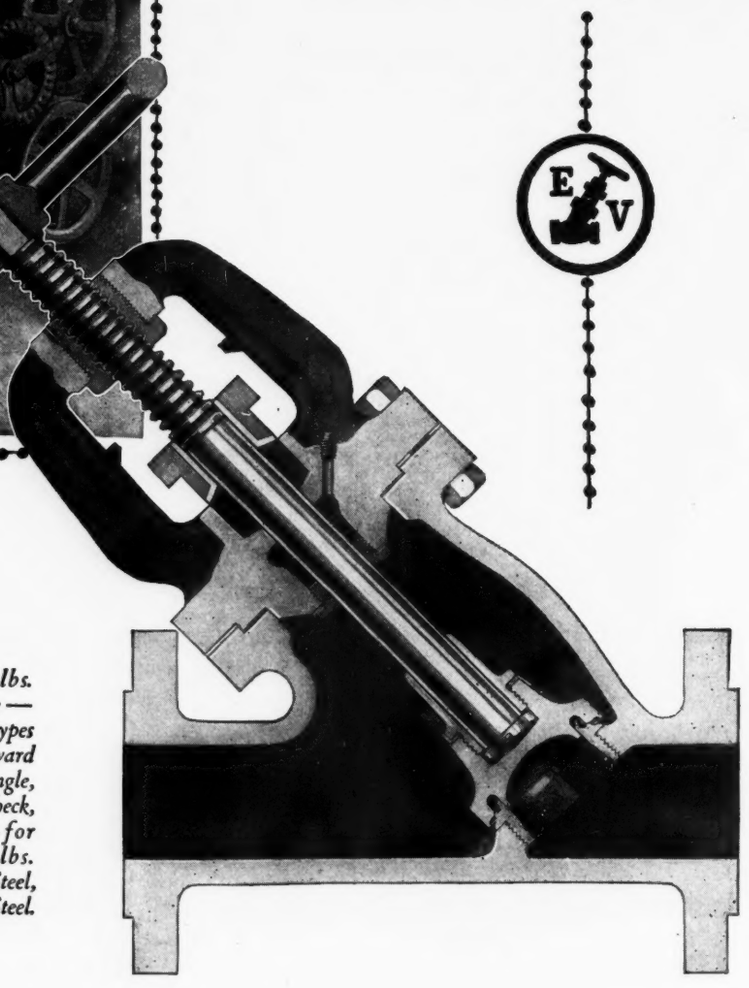
Confidently . . .



FROM an extensive range of styles and sizes you can confidently specify Edward valves to meet accurately your every demand for long life, low maintenance and dependability.

The advanced design, improved materials and careful workmanship which are characteristic of Edward valves have won for them the solid preference of leading engineers.

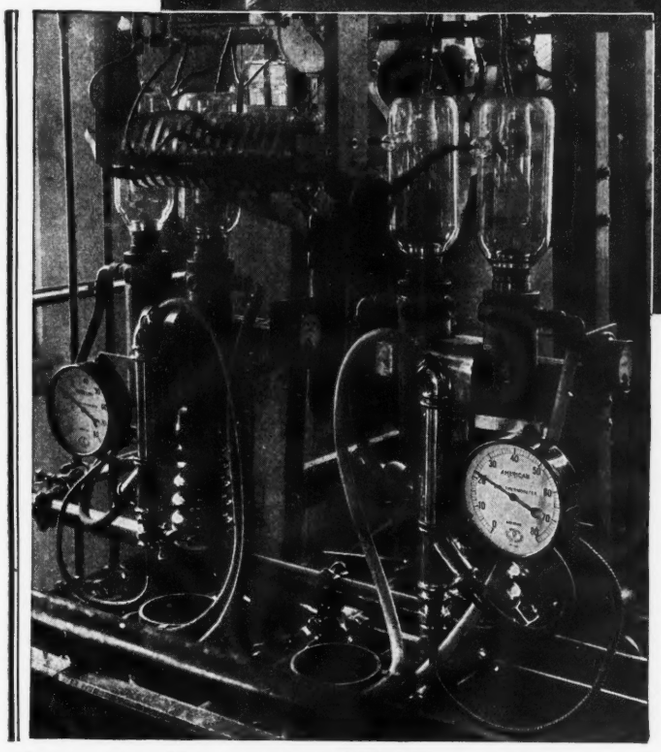
Ask for the Edward catalog.



No. 741: Cast Steel, 400 lbs. W. S. P. Blow-off Valve — one of many Edward types in general use. Other Edward types are: Globe and angle, Blow-off, Feed-Line, Check, Atmospheric Relief — for pressures up to 1350 lbs. W. S. P. and in Cast Steel, Semi-Steel, and Forged Steel.

EDWARD VALVE & MANUFACTURING COMPANY
Main Office and Plant, East Chicago, Indiana
REPRESENTATIVES IN ALL PRINCIPAL CITIES

This is Station WJZ!



The American Mercury Actuated Dial Thermometers used are guaranteed accurate and dependable. They are made for any temperature range from minus 40 to 1000° F.

When you tune in on station W J Z, you expect reception—smooth, continuous and without interruption. And you get it. For in broadcasting from this station, every precaution is taken against possible breakdown.

Take the vacuum tubes, for example. They are expensive and in use constantly. Ten thousand volts are applied to the plate electrode of each tube. The plates must be cooled by water. Otherwise they become white hot and the tubes burn out. Here's the biggest factor in operating expense.

The circulating water is kept at 22° C. You can easily read the temperature on the dial. Any rise in temperature indicates trouble. Thus the dial thermometers are tangible investments.

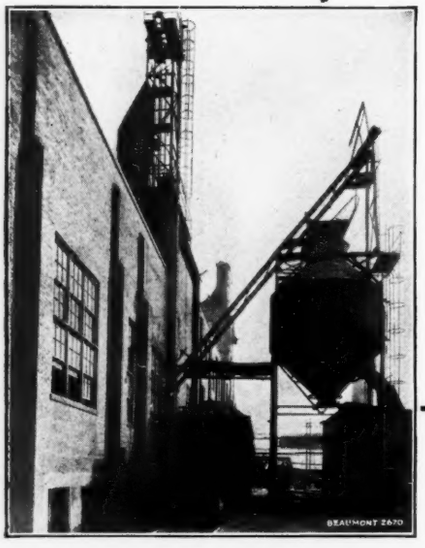
Specify Catalogs Desired

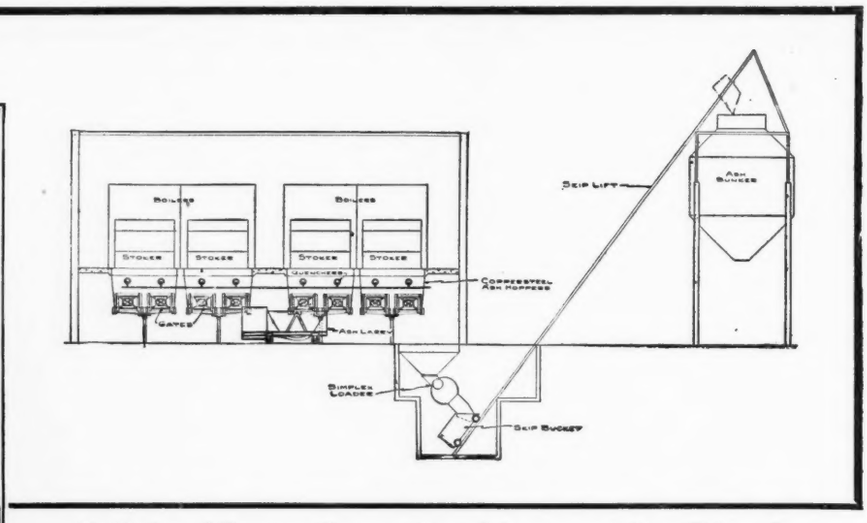
American Dial Thermometers	G-32
Consolidated Safety Valves	Z-32
Hancock Globe & Check Valves	X-32
American Recording Thermometers	H-32
American Temperature Controllers	R-32
Ashcroft Power Control Valve	M-32
Metropolitan Injectors	Y-32
American Relief Valves	V-32
American Glass Thermometers	F-32
Ashcroft Gauges	T-32
American Quality Gauges	A-32
American Recording Gauges	E-32
American Draft Gauges	B-32
American Gauge Testers	D-32
American Tachometers	J-32

AMERICAN INSTRUMENTS
SINCE 1851

CONSOLIDATED ASHCROFT HANCOCK COMPANY, INC.
Subsidiary of Manning, Maxwell and Moore, Inc.
100 East 42nd Street, New York .... 605 W. Washington Blvd., Chicago

This "Complete"* System Ends Your Ash Removal Worries!





Application of Beaumont System. One of three types—Motor Driven Car and Full Automatic Skip Hoist

Let's look at the Ash Handling problem frankly. The Beaumont Skip-Lift Ash Handling System takes the ashes from the boilers and puts them overhead in a storage bunker. From here, they are chuted direct to trucks or railroad cars by gravity. Only one man, part time, *completely** handles all the ashes. No rehandling of ashes is necessary.

Compare this with a system that only handles ashes horizontally and then puts it up to the yard gang to dig the ashes out of a pit to load into trucks or railroad cars. Real economy in ash handling is only obtained in the complete system.

Let a Beaumont Engineer explain in more detail the advantages of our *complete** ash disposal system.

***Complete—(Webster) Entire, Absolute, Finished.**

A partial list of installations

Atlantic Refining Company, Philadelphia, Pa.
Central Illinois Light Co., Peoria, Ill.
Continental Paper Co., Bogota, N. J.
Connecticut Company, Hartford, Conn.
Dodge Bros., Detroit, Mich.
Hyatt Roller Bearing Co., Harrison, N. J.
Johns-Manville, Inc., Manville, N. J.
General Motors Corp., Frigidaire Div., Dayton, Ohio.
Fisher Body Co., Flint, Mich.
National Sugar Refg. Co. of N. J., Long Island, N. Y.

"Ash Sales" revenue is increased because the Beaumont system keeps the ash clean and dry. (Ashes are stored overhead and are quickly chuted to trucks or railroad cars.)

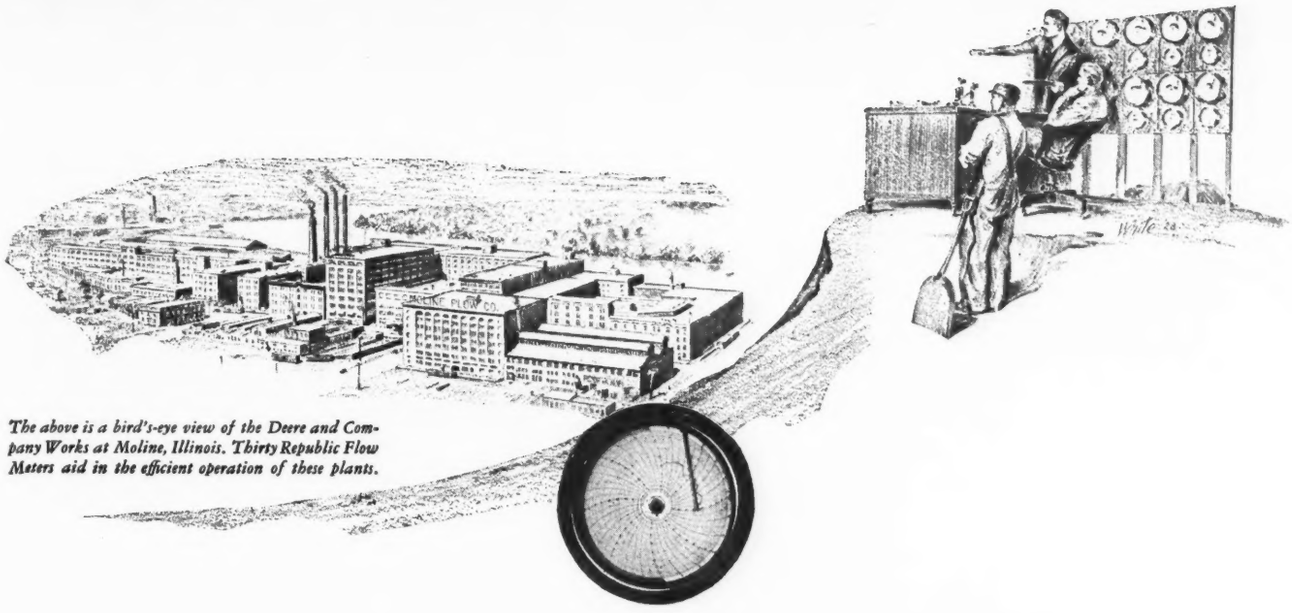
BEAUMONT MFG. CO.

322 Arch Street, Philadelphia

BRANCH OFFICES:

CHICAGO ..... Straus Bldg.	MINNEAPOLIS ..... Plymouth Bldg.
DETROIT ..... Kresge Bldg.	ST. LOUIS ...Railway Exchange Bldg.
NEW YORK .....50 Church St.	BOSTON.....12 Pearl St.
PITTSBURGH....Union Trust Building	
CLEVELAND.....Keith Building	TORONTO ...Bank of Hamilton Bldg.
OMAHA .....First Nat'l Bank Bldg.	MONTREAL ..... Drummond Bldg.

BEAUMONT *SKIP-LIFT* ASH HANDLING SYSTEM



The above is a bird's-eye view of the Deere and Company Works at Moline, Illinois. Thirty Republic Flow Meters aid in the efficient operation of these plants.

Come Up on the Hill *with* Republic

MAGNITUDE—the one feature which gives modern industry its greatest strength is also its greatest weakness. Its specialized departments—each a small plant in itself—each functioning under its own superintendent—the power plant—the foundry—the shops and scores of others peculiar to the industry—each doing a certain job, independent—yet with vital effect on one another and the finished product. They are sculptors of industry all working toward one end—the shaping of a perfect product.

Someone must co-ordinate their efforts—someone must have a hill-top view of the entire field of activity. Centralized control is essential where the best product is to be produced at the lowest cost.

The president or general manager, whose efforts are guided and backed by a complete and accurate record of the generation—distribution—and utilization of power in his plant, can co-ordinate the efforts of each department to their highest degree of productivity.

Bulletin "Steam Economy" mailed on request

REPUBLIC FLOW METERS COMPANY

Executive Offices and Plant · 2222 Diversey Parkway · Chicago, Ill.

Branch Offices in 25 Principal Cities

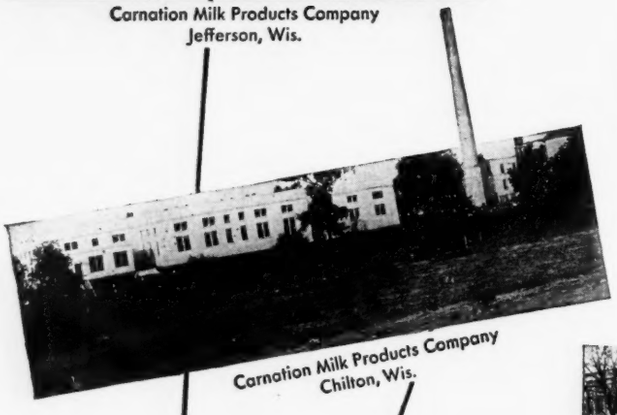
DOMINION FLOW METERS CO., *Toronto, Canada* ELEKTROFLO, *Berlin, Germany* ELECTROFLO METERS CO., *London, England*

REPUBLIC FLOW METERS

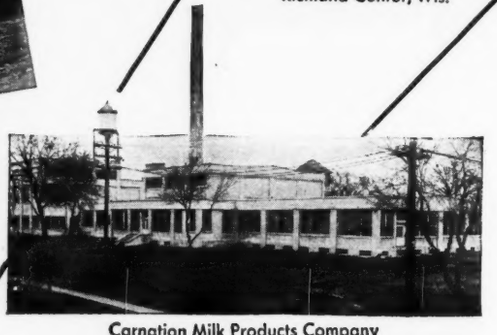
THESE

Carnation Milk Products Company
Jefferson, Wis.

Carnation Milk Products Company
Richland Center, Wis.



Carnation Milk Products Company
Chilton, Wis.



Carnation Milk Products Company
Waverly, Iowa

Carnation Milk Products Company
Oconomowoc, Wis.

Carnation Milk Products Company
Mt. Vernon, Mo.

Carnation Milk Products Company
Berlin, Wis.

COMBUSTION

7 PLANTS

OF CARNATION MILK PRODUCTS COMPANY ARE EQUIPPED WITH COMBUSTION ENGINEERING STOKERS

Steam for pasturization, sterilizing, processing, for power and innumerable other purposes is necessary to maintain the high standard of Carnation Milk Products. There can be no compromise — a dependable and continuous steam supply is imperative.

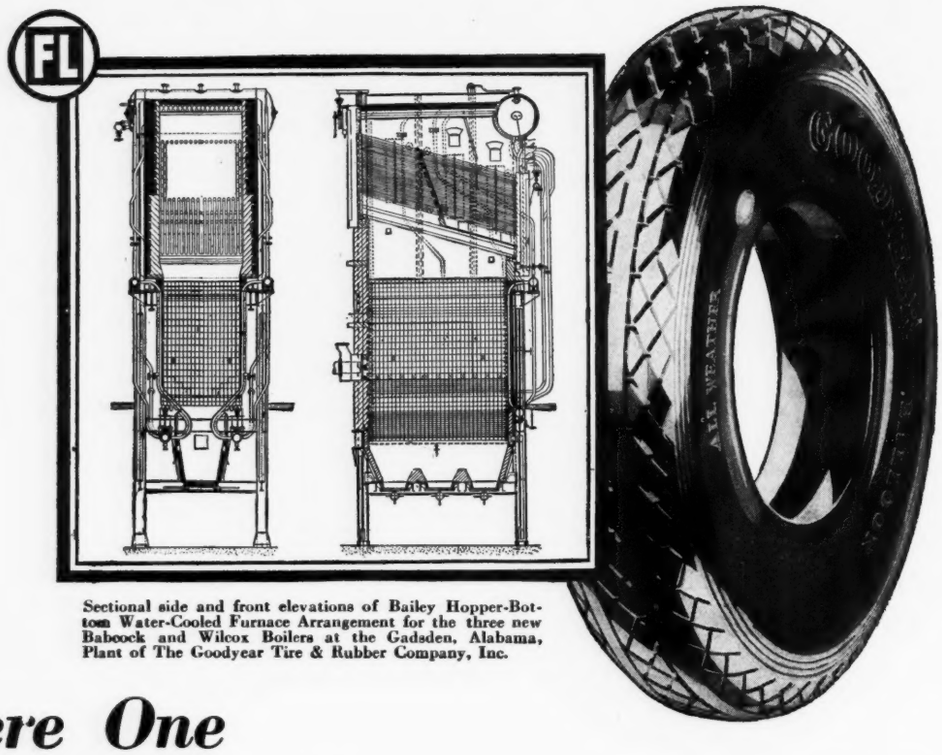
Combustion Engineering Corporation's fuel burning equipment is installed in seven Carnation Milk plants. The first installation was made eleven years ago. Since that time numerous repeat orders have been received. As new plants were added, Combustion Engineering Stokers were installed.

Many of America's leading manufacturers entrust to this organization their problems of meeting increasing steam demands. This confidence is based upon the record of past performance and a knowledge that Combustion Engineering Corporation offers equipment designed to produce a dependable supply of steam at a minimum cost.

We will gladly send a copy of our Condensed Catalog which describes equipment which is reducing steam costs in hundreds of installations.

COMBUSTION ENGINEERING CORPORATION
International Combustion Building · 200 Madison Avenue, New York
A SUBSIDIARY OF INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

ENGINEERING



Sectional side and front elevations of Bailey Hopper-Bottom Water-Cooled Furnace Arrangement for the three new Babcock and Wilcox Boilers at the Gadsden, Alabama, Plant of The Goodyear Tire & Rubber Company, Inc.

Where One Bailey Furnace is Installed Others Generally Follow

This Time in Power Plants of The Goodyear Tire & Rubber Co., Inc

2 Bailey Water-Cooled Furnaces were installed late in 1926 on two existing boiler units for power and process steam in Power Plant No. 2 of The Goodyear Tire & Rubber Company, Inc., Akron, Ohio, in order to permit the boilers to be operated at higher ratings with low furnace maintenance.

6 Bailey Water-Cooled Furnaces were installed by the same manufacturer on six additional boilers in Power Plants No. 1 and 2 late in 1927.

5 additional Bailey Water-Cooled Furnaces will be installed this year. Two will replace refractory furnaces on existing boilers in Plant No. 2 at Akron. The other 3 will be installed on three new Babcock and Wilcox Boilers of 6590 sq. ft. of heating surface each in the Gadsden, Alabama, Plant. These boilers are guaranteed to deliver a maximum of 65,000 lb. of steam per hour (corresponding to 300 per cent of rating).

This total of

13 Bailey Water-Cooled Furnaces installed by this one manufacturer in a period of less than two years, is evidence of the satisfactory performance and economy of this type of furnace construction.

Ask us to send you a portfolio of Technical Papers and Descriptions of Bailey Furnace-Wall Installations.

FULLER LEHIGH COMPANY, FULLERTON, PENNA.~ *A Babcock & Wilcox Organization*

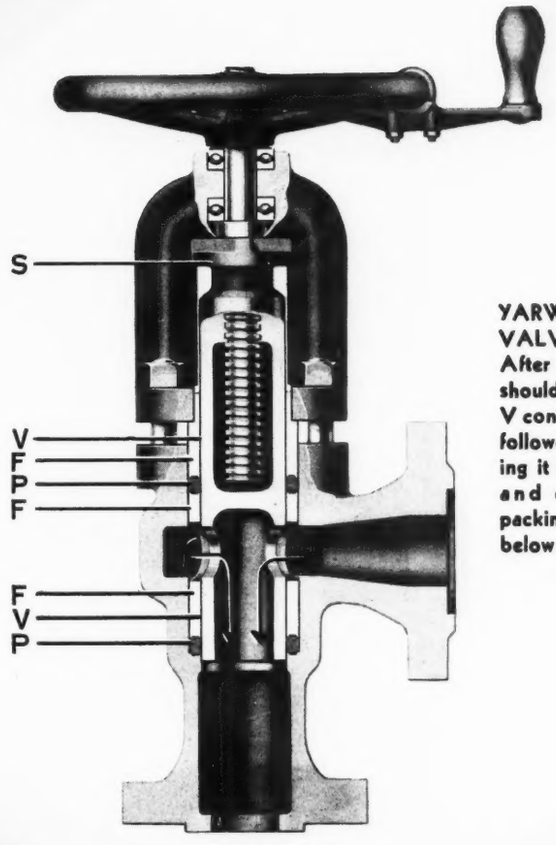
1-96

FULLER LEHIGH

PULVERIZED-COAL EQUIPMENT ~ WATER-COOLED FURNACE WALLS

YARWAY

BLOW-OFF VALVES



YARWAY SEATLESS VALVE Operation:— After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packing P above and below port.

NO SEAT TO LEAK

— No Seat to Leak.

— Used in over 10,000 plants.

— Made of gray iron, electric furnace and forged steel for all pressures to 1400 lbs.

— Send for Booklet B-410-C.

YARNALL-WARING COMPANY
Mermaid Avenue Philadelphia

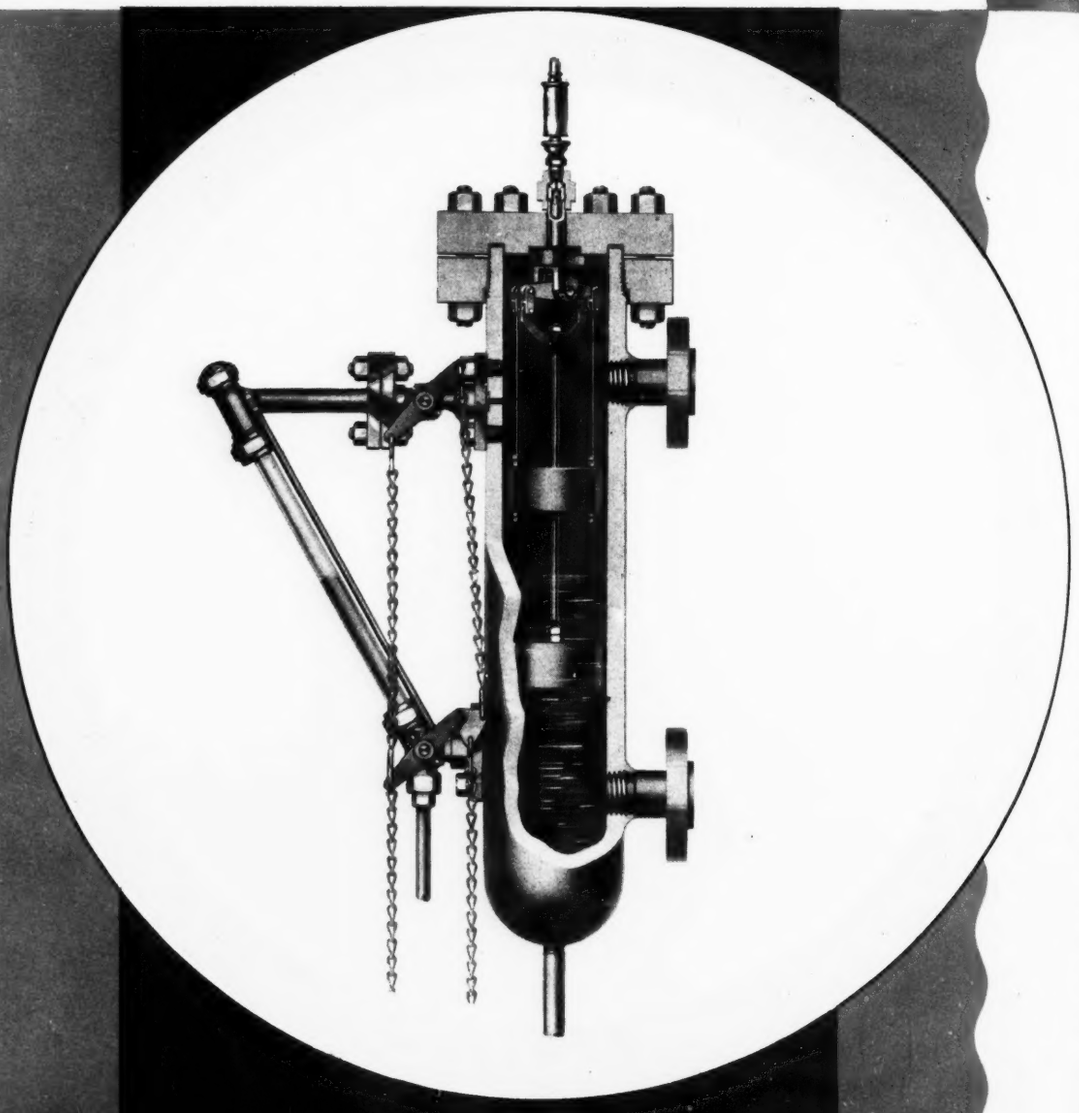
YARWAY

FLOATLESS HI-LO ALARM WATER COLUMN

.. and ..

SE-SURE INCLINED WATER GAGE

NO FLOATS TO SINK



— Operates on the displacement principle with Solid Weights — has no floats.

— Used in leading plants from coast to coast; from Canada to the Gulf.

— Inclined Gage Glass for easy reading of high boiler water levels.

— Made of gray iron and forged steel for all pressures to 1400 lbs.

— Send for Booklet WG-1802.

YARNALL-WARING COMPANY
Mermaid Avenue Philadelphia

When it comes to the transmission of Power... Cog-Belt Drives will do the job *with greater efficiency..at less expense.. and for a longer time!*

AND in addition, the Dayton Cog-Belt Drive offers ten advantages that are found in drives of no other type:

1 MINIMUM SPACE REQUIRED
Smaller pulleys and extremely short center to center distances possible without use of idlers.

2 POSITIVE SPEED
Exact speed ratio maintained through greater gripping power.

3 RUGGED
Unaffected by dust or moisture-laden atmospheres.

4 SMOOTH STARTING AND RUNNING
Through "seating" action of belts in grooves.

5 VIBRATION ELIMINATED
No vibration transmitted between driving and driven machines.

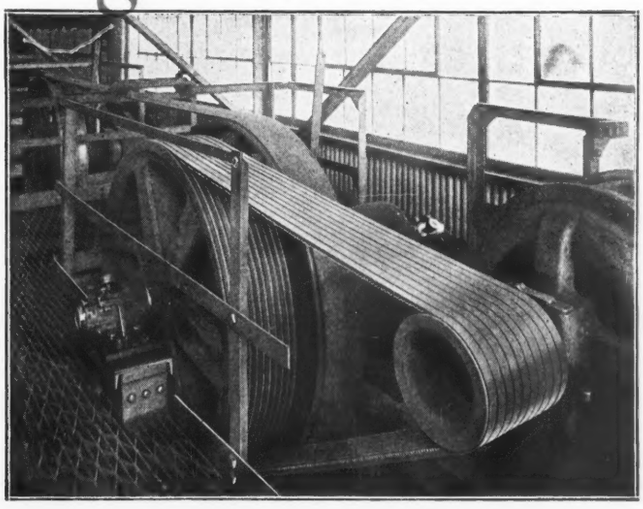
6 LESS MAINTENANCE
Due to long life, belt replacement extremely infrequent. No lubrication necessary. No dressing.

7 LESS ADJUSTMENT
Pre-stretched construction and correct mechanical design eliminate necessity of frequent "take-ups."

8 QUIET
Particularly recommended wherever quietness is essential.

9 CLEAN
No oil or grease to leak or collect dust.

10 EASY ON BEARINGS
Greater gripping power permits less tension.



Such advantages of the drive proper are made possible only through the superior and exclusive features of the Dayton Cog Belt. See the belt itself. Convince yourself that this is the belt for your machines. Mail the coupon for a sample section today.

The DAYTON RUBBER MFG. CO., Dayton, Ohio
Factory Distributors in principal cities and all Westinghouse Electric & Mfg. Company's Sales Offices

MAIL THIS COUPON

THE DAYTON RUBBER MFG. COMPANY
Dayton, Ohio

Gentlemen: Without obligation on my part, please send free sample section of Dayton Cog-Belt as offered. I am interested in Dayton Cog-Belt Drives for

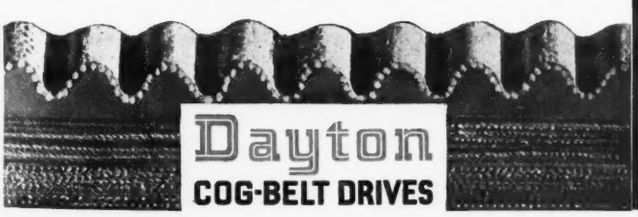
☐ Use in plant ☐ Use on product

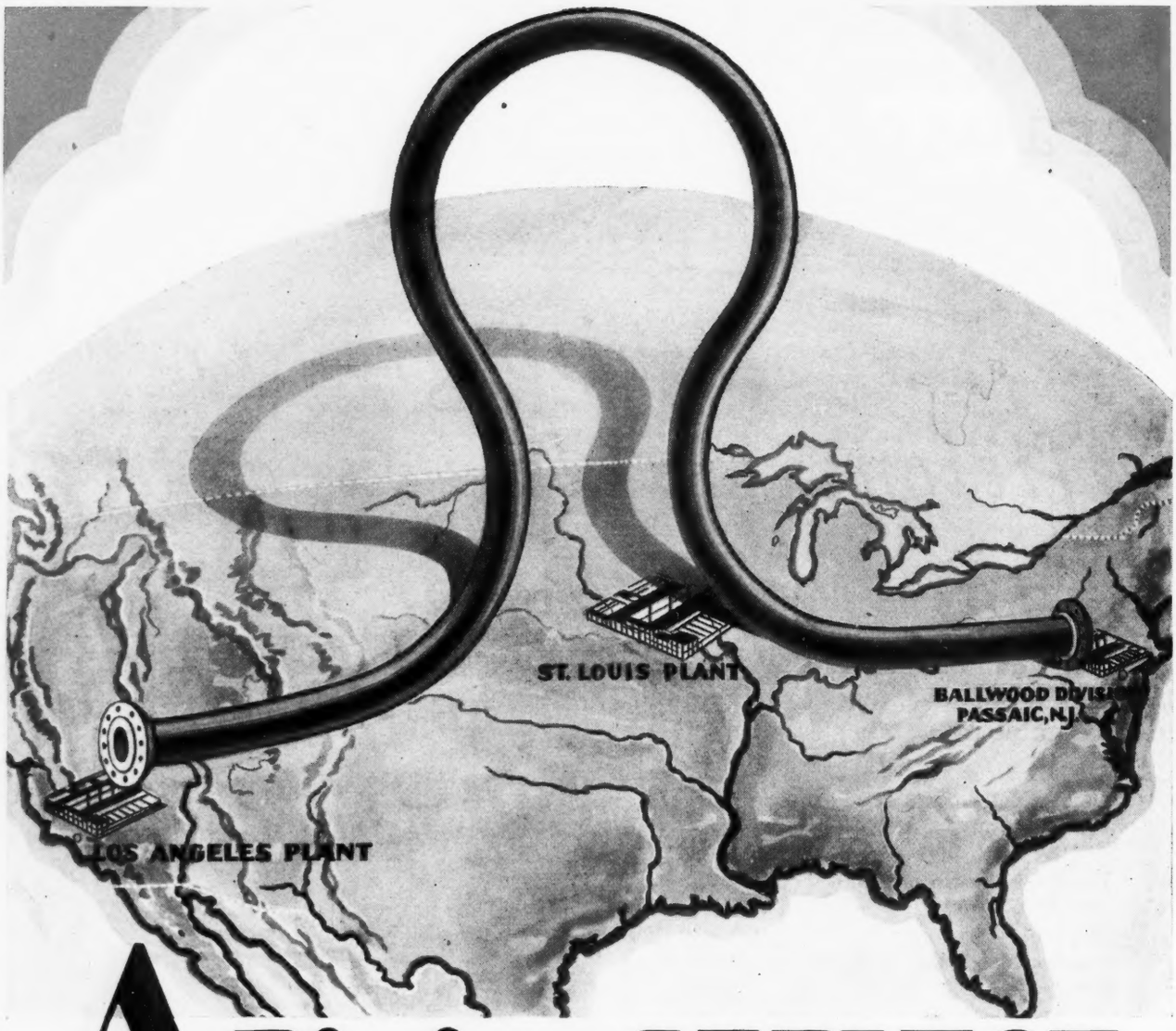
*Name*_____

*Company*_____

*Street*_____ *City*_____ *State*_____

B-2





A Piping SERVICE *that Spans the Country*

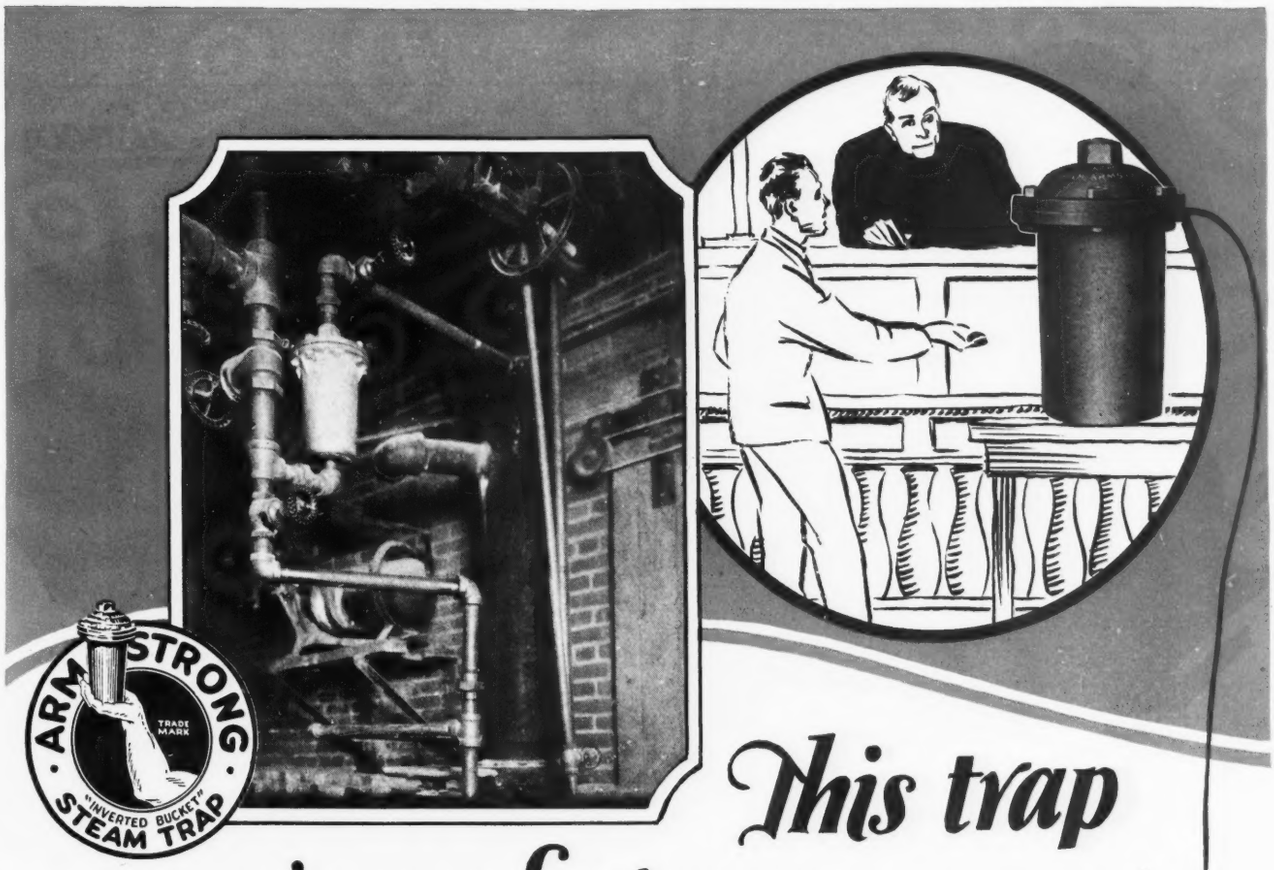
THE recent consolidation of The Ballwood Company (piping fabricators since 1905) with Midwest completes the span of effective piping service from coast to coast.

It is a service that makes available to users of power plant, industrial process, and oil refinery piping: (1) an unexcelled store of specialized piping experience, (2) a highly competent organization with adequate facilities to function efficiently on any size or type of piping project irrespective of location, (3) the economies attained through large scale operation.

MIDWEST PIPING & SUPPLY CO., INC.
Plants at St. Louis, Los Angeles, and Passaic, N.J. (Ballwood Div.)

Offices: St. Louis - Chicago - Tulsa - Los Angeles - New York (Ballwood Div.)

a Greater MIDWEST PIPING SERVICE



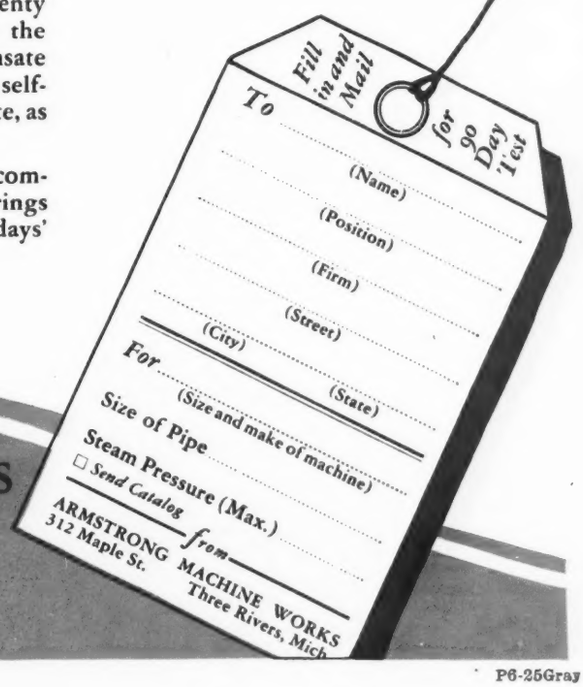
This trap can't sue for non-support—

FAILURE to provide (a support) is no valid argument in the case of the Armstrong Steam Trap. It's light and compact enough to work efficiently without special support, as the picture taken in the Loose-Wiles Biscuit Company plant in Kansas City, Mo., shows.

Its claims for long trouble-free service, however, get plenty of support. Thousands of installations have proved the ability of the Armstrong Trap to discharge condensate positively and automatically, without air binding. It's self-scrubbing also—sludge is discharged with the condensate, as well as oil, scum, gases and entrained air.

To prove these strong statements we can make you a "companionate" proposition. Your name on the tag below brings you as many Armstrong Traps as you require, for 90 days' trial—without cost to you or obligation.

Made in sizes and types for pressures to 900 lbs. and temperatures to 750° F.

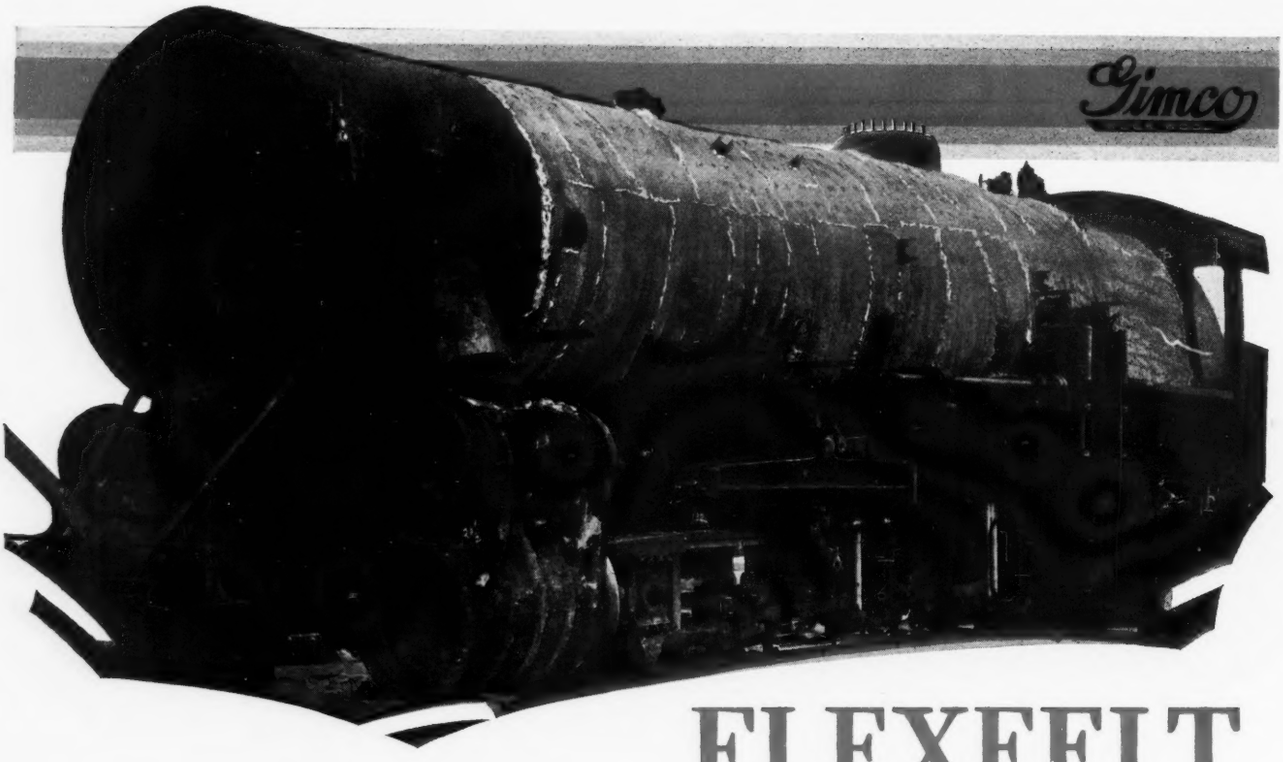


ARMSTRONG MACHINE WORKS

312 Maple Street :: Three Rivers, Michigan

District Representatives in 42 Cities

P6-25Gray



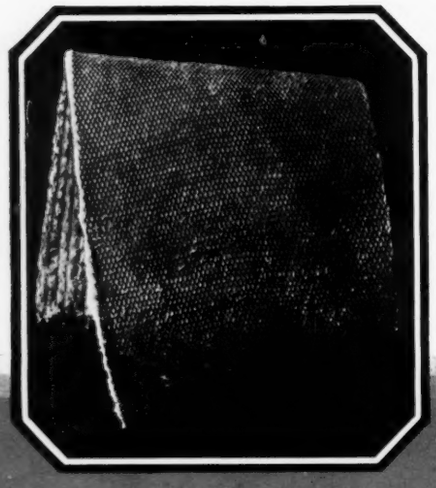
FLEXFELT

Locomotive Boiler Lagging

Flexfelt Locomotive Lagging is made from Gimco long fibered Annealed Rock Wool. Flexfelt is the modern insulation for increasing the efficiency of all locomotives.

The United States Bureau of Standards tests prove that the heat loss through Rock Wool is only about half of that of the old-fashioned types of insulation. Another advantage that Flexfelt has is that the labor of application is low and there are no cracks in the insulation to allow the heat to escape and be wasted.

The edges of the Flexfelt blanket are soft and when these edges are butted together, the density of the material at the joints is the same as the balance of the blanket.



All wide-awake steam railroad engineers are interested in Flexfelt, as it is an opportunity to decrease the heat loss and increase the efficiency of their boilers. Flexfelt has been used for years for the insulation of stationary boilers and has proven very satisfactory for this purpose. It has been used for a number of years for tank car insulation.

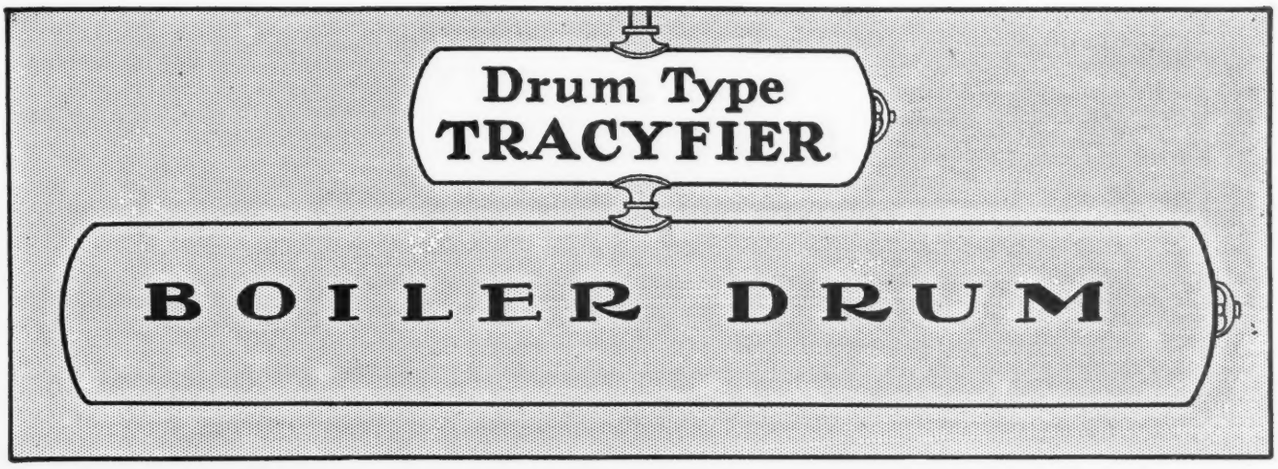
Write for our Flexfelt catalogue which describes the various types of metal fabric combinations that are available.

Eastern Representative:

General Insulating Products Co., Brooklyn, N. Y.

GENERAL INSULATING & MANUFACTURING CO.

Alexandria, Indiana



Installs OUTSIDE of Boiler

Absolute, Definite GUARANTEE

The Drum Type Tracyfier (as well as the Tracyfier and the Pipe Line Tracyfier) is guaranteed to deliver Standard Specification Steam as exactly defined below:

DRY

Steam shall be free from all moisture. Throttling calorimeter tests shall at all times show 100% dry steam, + or — not more than 2-10ths of 1%, based on the determined normal of the calorimeter. The permitted variation of + or — 2-10ths of one per cent is the tolerance for unavoidable variations in radiation, and thermodynamic changes.

CLEAN

Steam shall be free from all solids—both soluble and insoluble. Samples of condensed steam shall not show more than nine parts total solids per million, which is the tolerance to cover dissolved copper and iron from the test condenser, unavoidable dust contamination during the collection of the sample and its evaporation, and unavoidable errors in the laboratory determination of total solids.

THIS UNIT consists of a standard TRACYFIER fully installed in a steel drum.

The unit is piped into the steam line the same as any other piece of equipment.

The TRACYFIER can be installed either inside the boiler drum or outside (as illustrated here) as preference or conditions may make desirable.

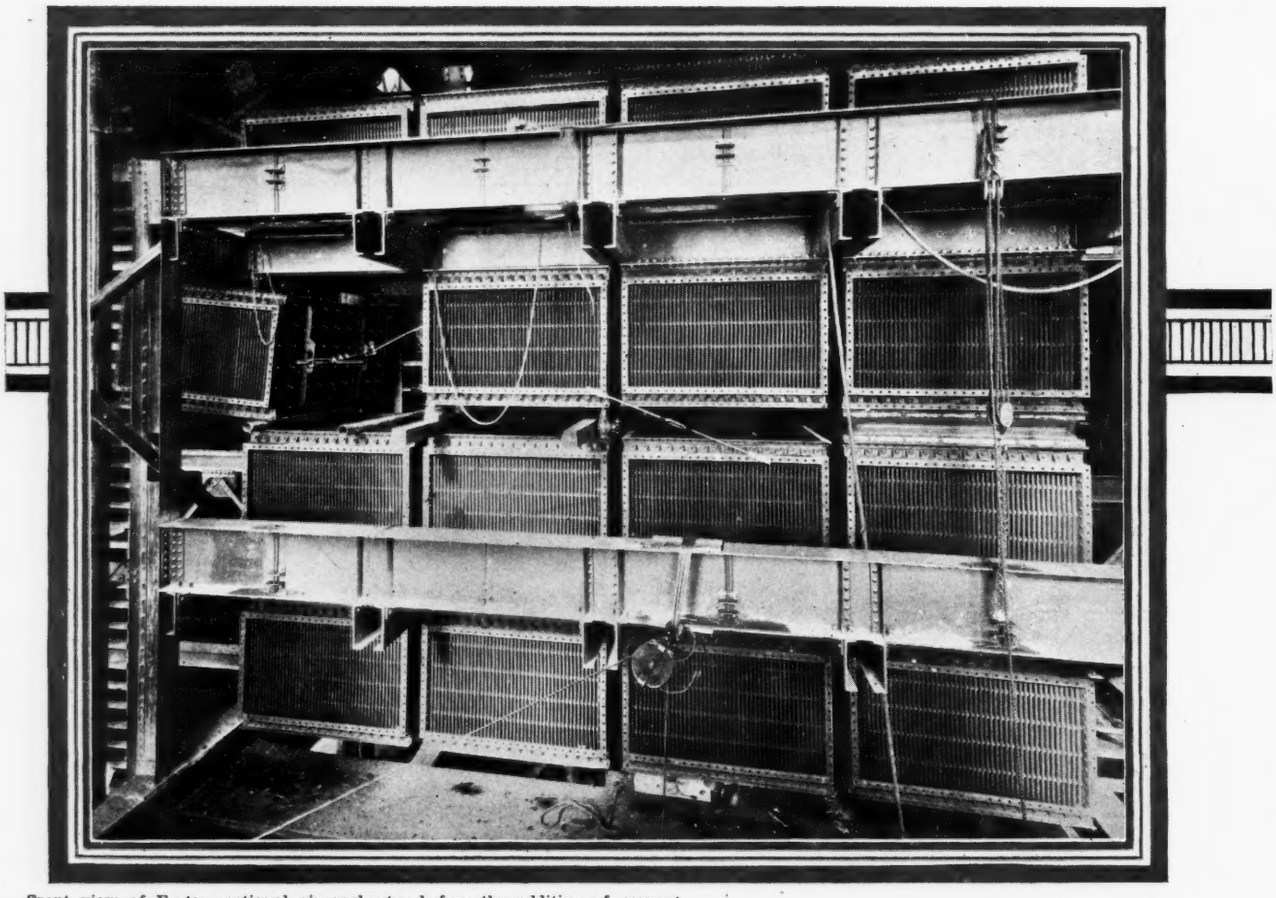
Savings made by using STANDARD SPECIFICATION STEAM soon repay the cost of the TRACYFIER and continue to pay dividends in the form of reduction of maintenance, lowered fuel bill, etc.

Ask for New Bulletin Number 1085

ANDREWS-BRADSHAW CO.
Division of
BLAW-KNOX CO.
651 Farmers Bank Bldg., Pittsburgh, Pa.

BLAW-KNOX

TRACYFIER
THE STEAM PURIFIER



Front view of Foster sectional air preheater before the addition of connecting ducts and insulation. The complete heater consists of 16 interchangeable sections. The last section is about to be placed into position.

51,000 Sq. Ft. Foster Air Preheater

The Foster sectional air preheater, shown in various stages of erection by the accompanying photographs, is one of six similar Foster preheaters installed in the Philo plant of the Ohio Power Company.

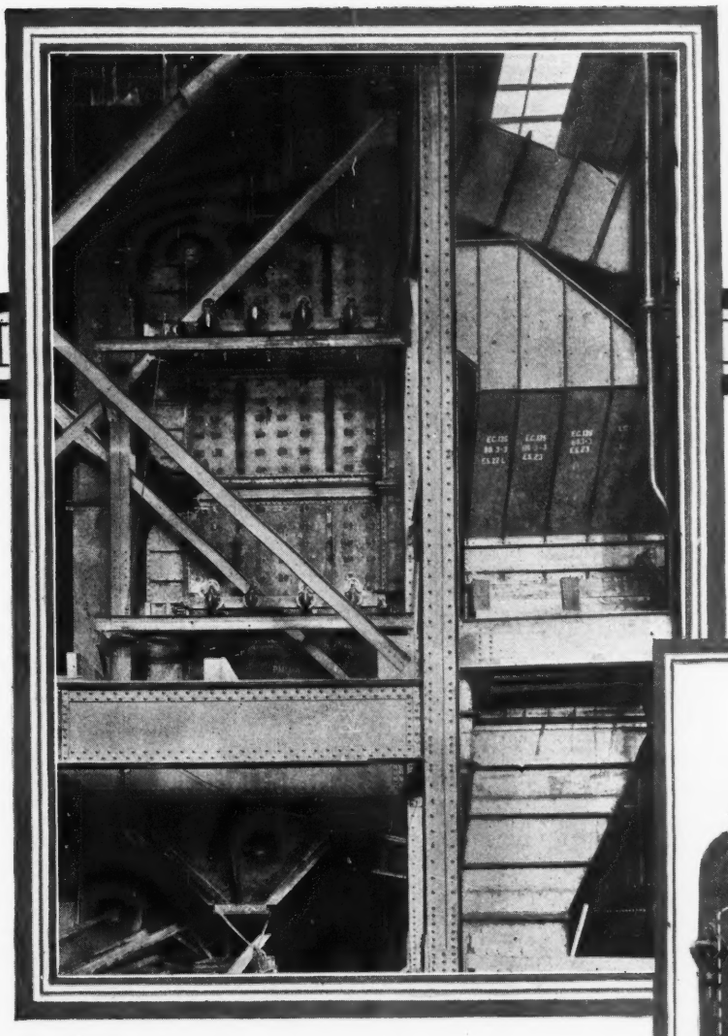
Each complete air heater consists of sixteen interchangeable sections and contains 51,000 sq.ft. of heating surface. The sections consist of parallel steel plates, with gases passing on one side and air on the other side of the plates. Each section is completely fabricated at the shops before shipment. The work of erection consists of merely bolting the sections into place.

The sections for these Philo heaters are arranged in groups four sections high. Four such groups are placed parallel to each other—making a heater four sections high and four wide.

Gases enter the top of the upper sections and pass vertically downward through the heater. Air enters the lowest sections and flows horizontally through the sections, leaving at the

AERO UNIT COAL PULVERIZERS
AIR HEATERS CENTRIFUGAL PUMPS
CONDENSERS COOLING TOWERS
ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

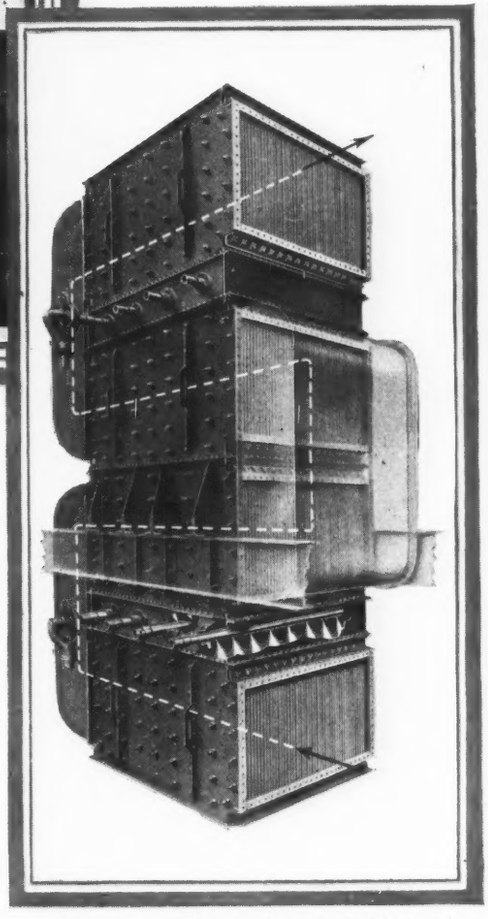
FOSTER



Side view of the Foster air preheater shown on the opposite page, but with the connecting ducts in place. The direction of air flow through the heater is indicated by the dotted line in the illustration below.

front of the uppermost sections. The path of the air through the heater is indicated by the dotted line in the illustration at the right.

These Foster preheaters are each designed to preheat more than 310,000 lb. of air per hour from 100 deg. to 519 deg. F. The quadruple counter- and cross-flow of gases and air assures efficient heat transfer for the heater.



Arrangement of four sections of the Foster air preheater, placed one above the other. The dotted line with arrows, indicates the path of the air flowing through the sections. Gases pass vertically downward through the heater. Four of these groups placed parallel comprise the Philo preheater.

FOSTER WHEELER CORPORATION

165 Broadway, New York

Branches in Principal Cities

Foreign Associates—
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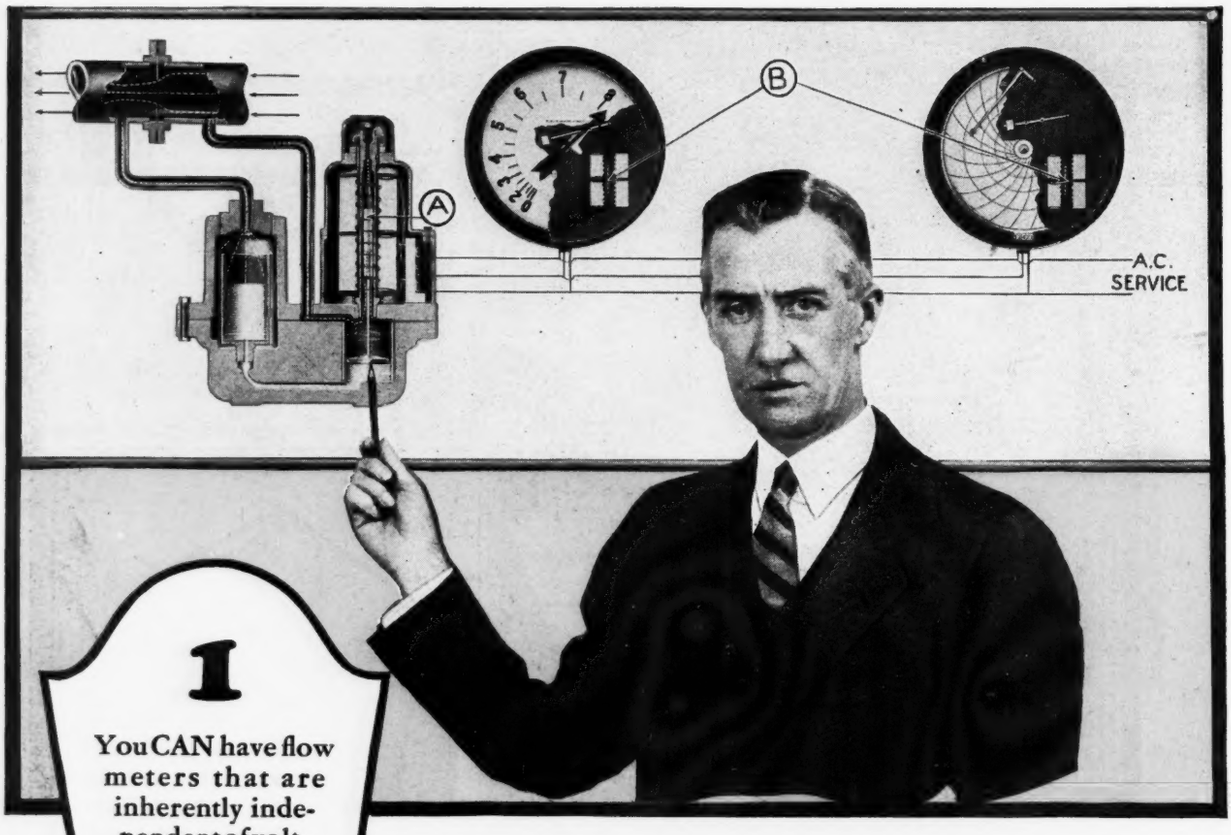
WHEELER

FRACTIONATING TOWERS HEAT EXCHANGERS
STEAM JET AIR PUMPS SUPERHEATERS
TUBE STILLS VACUUM PUMPS
WATER COOLED FURNACE SURFACES
BRASS AND COPPER TUBING AND PIPE

Vary Voltage–No Effect



1

You CAN have flow meters that are inherently independent of voltage swings.

The Inductance Bridge Principle

HERE is a flow meter that will remain accurate even though the line voltage should vary 30% up or down. Think of it—an extreme fluctuation of 60% may occur, yet the accuracy of the meter is unaffected. This indifference to voltage fluctuations is obtained without any complications—with no transformers—no compensators. It is an inherent characteristic of the inductance bridge principle on which the design of this flow meter is based.

All there is in the pressure chamber is the mercury and the float. Motion of the float moves the armature A, inside a special pressure-resisting, non-magnetic alloy tube, inducing magnetic field changes in the surrounding coil. This causes armature B to move similarly in the connected instruments, accurately following the change in flow. No contacts. Extreme simplicity. High accuracy. Quick responsiveness. *Write for Folder 80-13.*

THE BROWN INSTRUMENT COMPANY, 4504 Wayne Avenue, Phila., Pa.

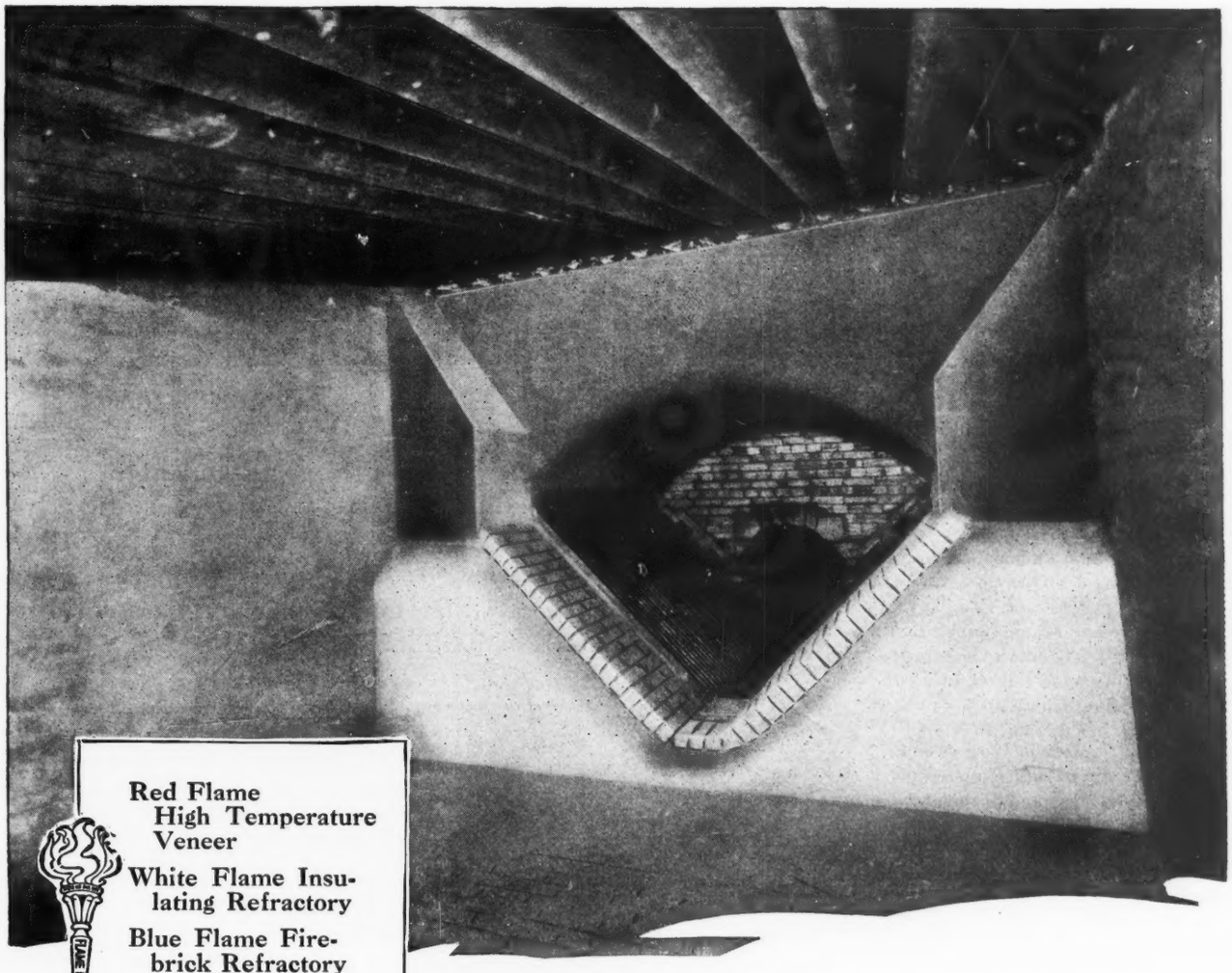
Branches in 20 principal cities

"To measure is to economize"

Brown Electric Flow Meter

on the Inductance Bridge Principle

Build Long Life into your Boiler Furnaces



- **Red Flame High Temperature Veneer**
- **White Flame Insulating Refractory**
- **Blue Flame Firebrick Refractory**
- **Plastikdo (wet) High Temperature Refractory**
- **Ramit for Rammed in Linings**
- **Kingbond Air Setting Refractory**
- **Kingdo Refractory Patch**

Make the linings give long trouble-free service, with minimum clinker adhesions by insisting upon

"FLAME BRAND" High Temperature Refractories

They will greatly outlast ordinary fire clays. Air tightness and freedom from rapid flame erosion are assured by the following practice for furnace temperatures above 3000 deg. F.

Lay all firebrick with "BLUE FLAME" with 1/8-in. flush joints that resist penetration and prevent spalling. Then apply a thin coating of "RED FLAME" Veneer, which quickly vitrifies into an air-tight hard glaze, giving the maximum protection against abrasion and clinker adhesion. Next apply "WHITE FLAME" Insulating Refractory to the tops of furnace arches and to all exposed surfaces, to cut down the radiation and air infiltration losses to the minimum.

For building Monolithic walls and patching furnace linings use "KINGDO." Unsurpassed in air-tightness, mechanical strength and durability. The use of "KINGDO" will assure permanency in the repair.

Write for free instruction book.

KING REFRACTORIES CO., INC.
1709-15 Niagara St., Buffalo, N. Y.

BUY NEW EQUIPMENT

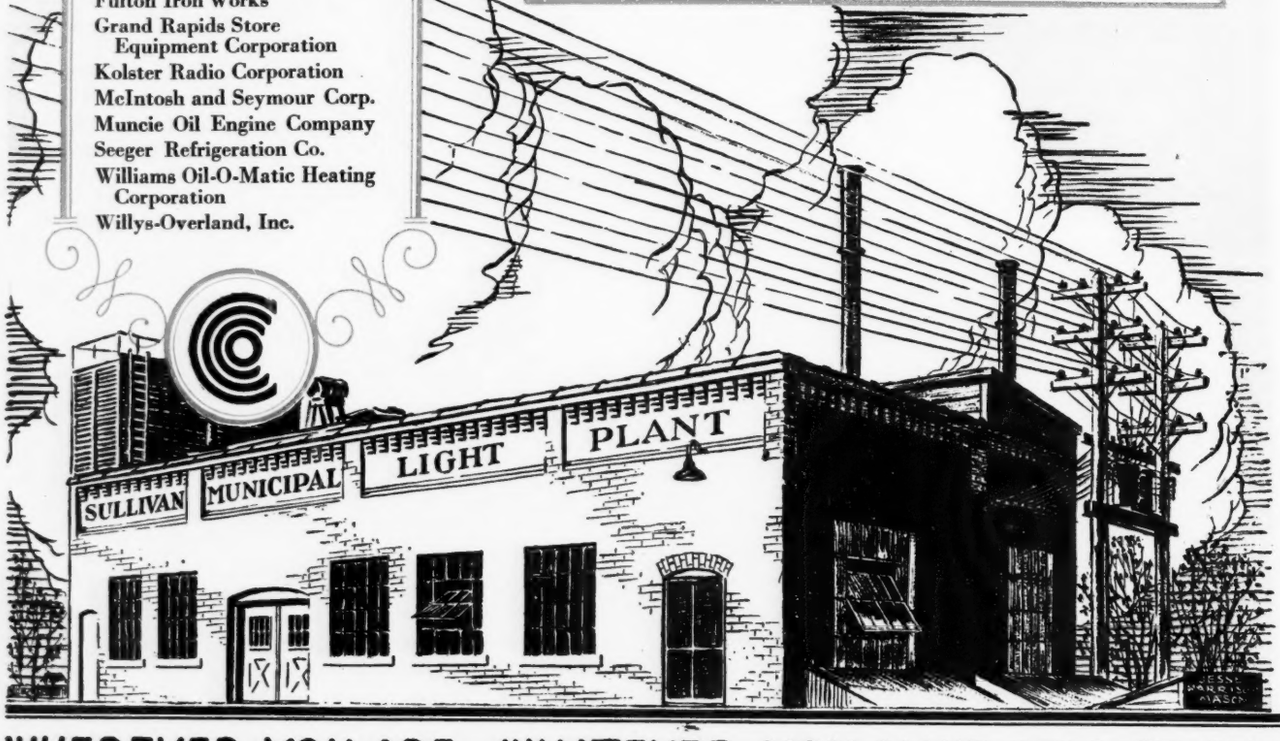
A complete plant

THE CITY OF SULLIVAN, Illinois, equipped its power plant with modern Diesel Engines purchased on a Commercial Credit Plan which allows payment from savings.

C. R. Cunningham, Superintendent of this plant says: "The saving in the cost of operation of the new plant is paying for the new machinery. In five years from the time of the installation, the present equipment shall be paid for."

COMMERCIAL CREDIT COMPANIES have exclusive contracts for their service with the outstanding concerns of all industry. Among others we find:

American Engineering Co.
Bessemer Gas Engine Co.
Chicago Pneumatic Tool Co.
Chrysler Sales Corporation
Copeland Sales Company
DeSoto Motor Corporation
Dodge Brothers Corporation
Thomas A. Edison, Inc.
Fulton Iron Works
Grand Rapids Store Equipment Corporation
Kolster Radio Corporation
McIntosh and Seymour Corp.
Muncie Oil Engine Company
Seeger Refrigeration Co.
Williams Oil-O-Matic Heating Corporation
Willys-Overland, Inc.



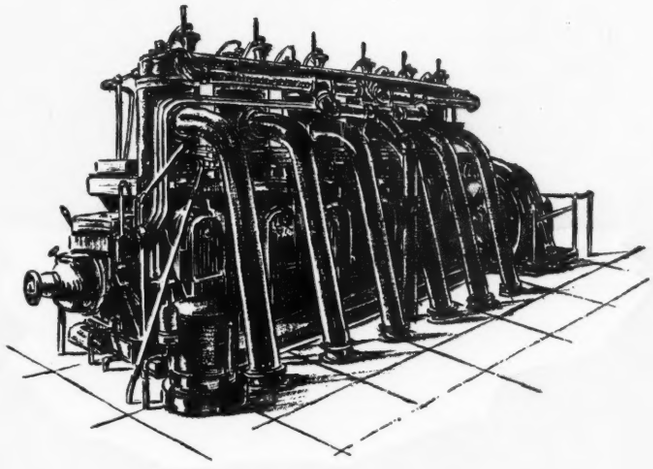
WHEREVER YOU ARE ··· WHATEVER YOU MAKE, SELL OR BUY

COMMERCIAL CREDIT

CASH CAPITAL & SURPLUS

OUT OF SAVINGS

or single units



WHETHER you need but one engine or are planning the erection of a completely equipped manufacturing plant, the negotiations for financing on a Commercial Credit Plan are simple in either case.

There is only one transaction which permits the buyer to pay for the new equipment or factory from savings or increased earnings effected.

Purchasing equipment or complete plants on the Commercial Credit Plan antiquates long drawn out negotiations, provides orderly amortization, is the most modern method of financing.

COMMERCIAL CREDIT PLANS

COMMERCIAL CREDIT deferred payment plans cover every sound field of instalment marketing. Automobiles, boats, machinery of all kinds, equipment in general, refrigerating units, heating plants, electrical appliances, store and office fixtures—more than a score of such broad classifications, including hundreds of individual products, fall within their scope.

¶ Through the purchase of receivables—open accounts, notes, acceptances—Commercial Credit Companies provide manufacturers and jobbers alike, with ample working funds at all times.

¶ Commercial Credit Companies have 175 full operating branch offices and 277 credit offices—452 offices in all—located in the principal cities in the United States where service is available. Commercial Credit service reaches out to Canada, Europe, Asia, Africa, Australia and South America and is being extended to all world-markets where conditions justify its introduction.

INVESTIGATE COMMERCIAL CREDIT SERVICE

COMPANIES COMMERCIAL BANKERS

$43,000,000.00

AMERICAN ENGINEERING COMPANY, PHILADELPHIA
AMERICAN ENGINEERING COMPANY, PHILADELPHIA
AMERICAN ENGINEERING COMPANY, PHILADELPHIA
AMERICAN ENGINEERING COMPANY, PHILADELPHIA
AMERICAN ENGINEERING COMPANY, PHILADELPHIA
TAYLOR STOKERS AT LORAIN STATION, OHIO PUBLIC SERVICE COMPANY
TAYLOR STOKERS IN AN INDUSTRIAL PLANT
Columbia Chemical Division, Pittsburgh Plate Glass Company, Barberton, Ohio

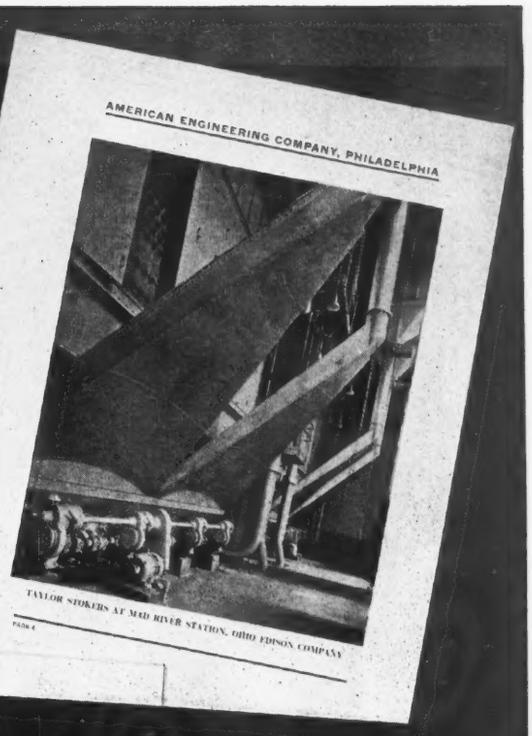
If you are interested in the

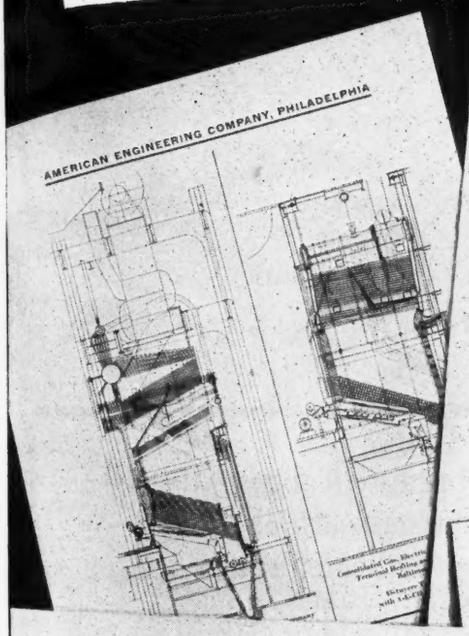
Cost of Steam

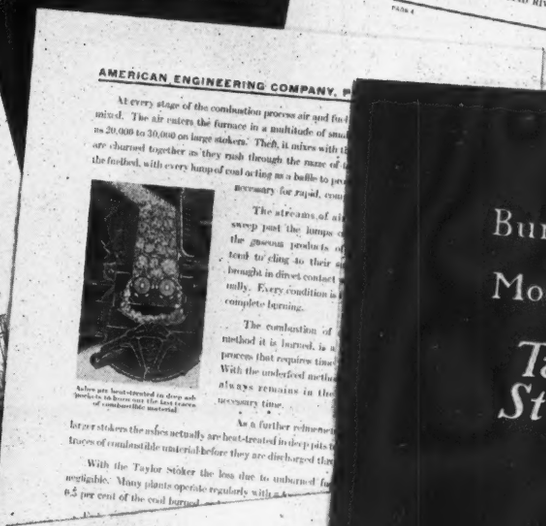
send for this profusely illustrated booklet, which explains the money-saving advantages of burning coal the modern, efficient way by the underfeed system on TAYLOR STOKERS. It is written for the executive, as well as the engineer.

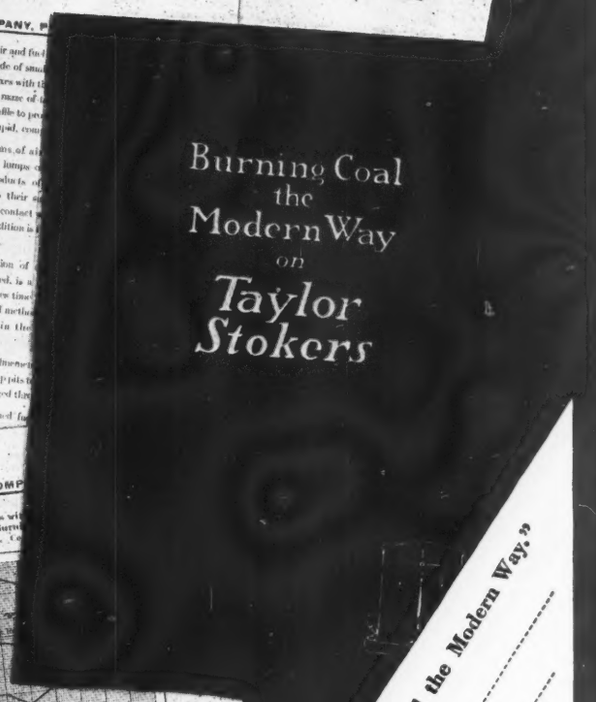
AMERICAN ENGINEERING CO.
Philadelphia, Pa.

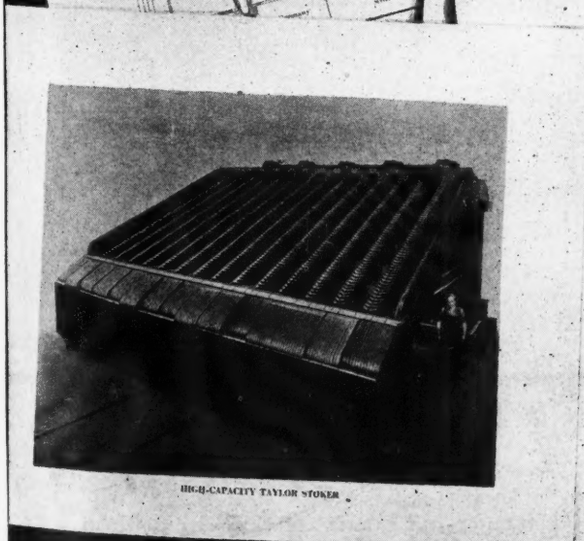
In Canada: Affiliated Engineering Companies, Ltd.
Head Office: Southam Bldg., Montreal

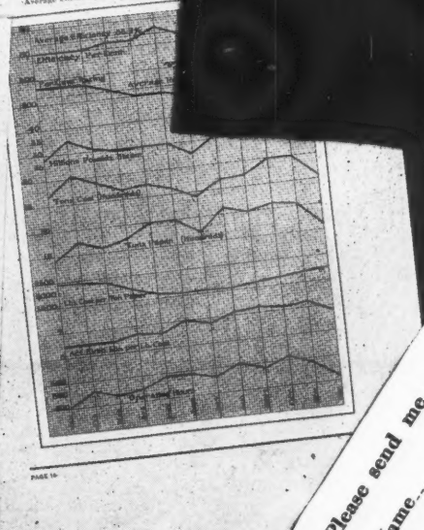












Please send me a copy of "Burning Coal the Modern Way."

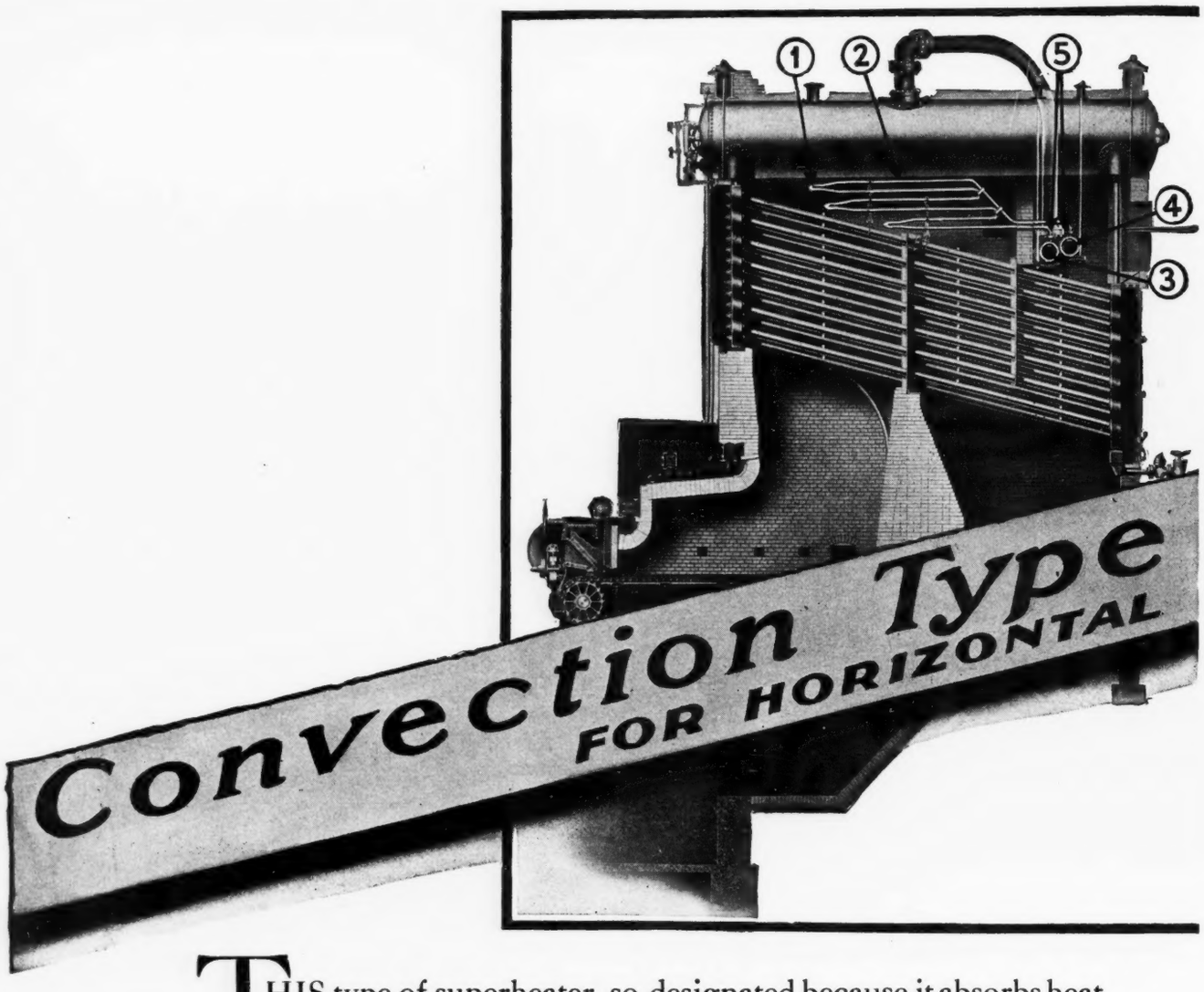
Name.....

Company.....

Street.....

City.....

State.....



THIS type of superheater, so designated because it absorbs heat primarily by convection, is located in the gas path above the first and second passes of the boiler. The superheater tubes are located above the boiler tubes, close to and parallel to them. Headers and unit joints are in the last pass (a comparatively cool zone) and are accessible through suitable access doors in the side wall or roof.

Such an arrangement is ideal for moderate steam temperatures and may in some cases be applied when higher temperatures are desired.

The degree of superheat obtainable with a given amount of heat-

1

Return bends, die-forged, join tubing to form multiple-loop, single-pass units of *any length*. Result: Full control over proportions of heating surface to steam area.

2

Units of heavy gage seamless steel tubing, with smooth interior and exterior finish, being of small diameter, provide large internal heating surface. Result: Designer enabled to use exact proportion of heating surfaces to produce required superheat with ample safety factor.

An adaptation of the Elesco multiple-loop, single-pass superheater which provides ..... a single pass of steam of any required length from the saturated to the superheated steam header, through multiple-loop units. Steam travels in the same direction through all units of the superheater in parallel, thereby maintaining uniform absorption of heat.

An exclusive Elesco development

ing surface depends upon the arrangement and location of the first baffle, since this factor determines the amount of boiler heating surface in the first pass. The smaller the amount of heating surface passed over by the gases before coming in contact with the superheater, the higher their temperature will be, and the higher the resulting superheat will be.

THE SUPERHEATER COMPANY
17 East 42nd Street, New York

Peoples Gas Bldg., CHICAGO — Union Trust Bldg., PITTSBURGH

CANADA: The Superheater Company, Limited, Montreal

Represented in

Atlanta Charlotte Denver Houston Kansas City Memphis New Orleans San Francisco

A-311

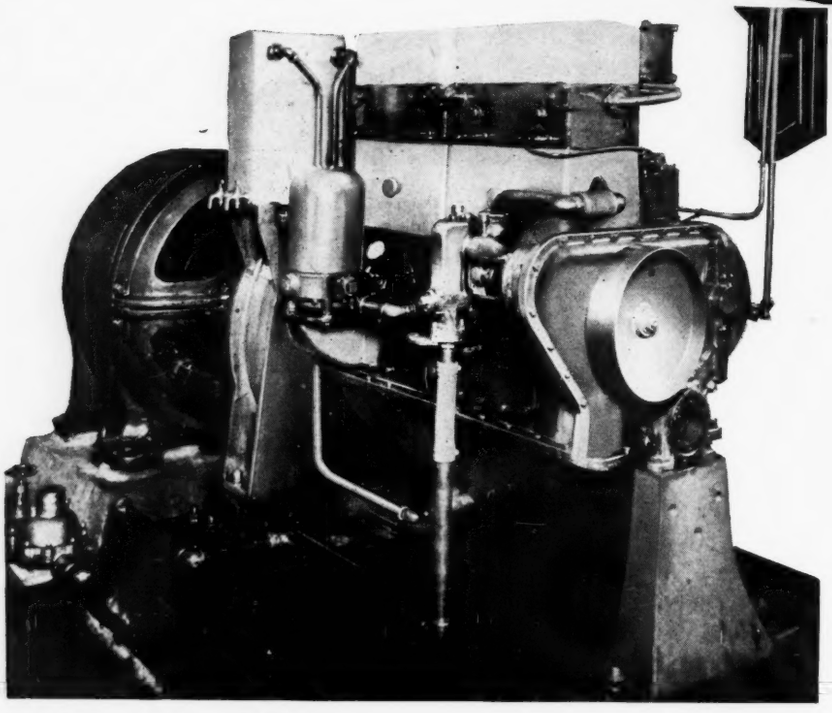
3-4

Saturated steam inlet and superheated steam outlet are always located at opposite ends of superheater. Each header is an unobstructed pipe throughout its entire length. Also, both the headers and the units have ample steam capacity. Result: Uniform distribution of steam through all the units at all loads.

5

Units are connected to headers by metal-to-metal ball joints, secured against any pressure by heat-treated steel studs and clamps. Result: A joint that can be broken simply by removing nut that holds unit clamp. Elimination of any other joints on units. Elimination of handholes in headers.

BUDA INDUSTRIAL POWER



BUDA-M.A.N. *High Speed* Diesel Generating Sets 40 to 100 KW— 50 to 125 KVA

Gasoline or Gas Generating Sets 5 to 75 KW or KVA

Here is one of the many applications

Many factory power plant generates alternating current only and as a result, some method must be had for delivering direct current to machinery on which alternating current is not desirable.

Many companies are turning to the Buda-M.A.N High Speed Diesel generating sets for this service. The installation here shows such a unit installed for supplying D.C. current to three 5-ton cranes and one 3-ton crane for the purpose of taking advantage of dynamic braking. D.C. current motors also afford a high starting torque and close speed regulation.

Buda-M.A.N Diesel power was chosen because of its low operating and maintenance cost on work of this type. The set used is a 65 kw. 900 r.p.m. 250-volt 260-ampere D.C. generator directly connected to a 92 h.p. four-stroke-cycle Diesel.

Both A.C. and D.C. units from 40 to 100 kw. and 50 to 125 kva. are available.

BUDA-M.A.N DIESEL engines are light weight and compact—assuring low installation cost. 92 to 180 H.P.

Continuous— unfailing power

The application of Buda Power to actual needs in Industrial, Municipal, or Central Station power plants are so numerous that it would be impossible to even list them here.

Just bear in mind that the Buda line of Gas, Gasoline, or High Speed Diesel engines will cover nearly every need whether used on continuous service generating sets, as illustrated here, on pumps, compressors, or as auxiliary power in these services.

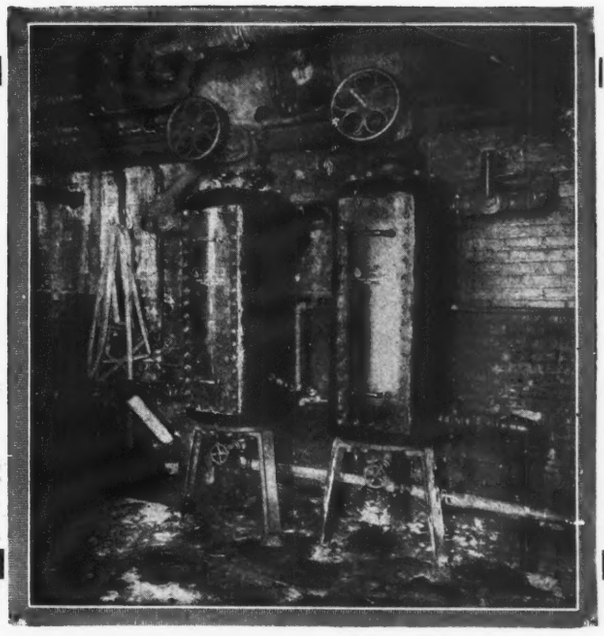
Particularly economical are the High Speed Diesel units permitting direct connected operation on both electrical generating and pumping service.

Get the details of Buda-M.A.N Diesel—their applications and low cost operating features. We will gladly send them on request.

THE BUDA COMPANY
HARVEY CHICAGO SUBURB **ILLINOIS**

BUDA ESTABLISHED 1881

Clean Hot Water



For boiler feed... process work... general service...

from any source of exhaust or low pressure steam

The Reilly Water Heater

Water is *kept clean* when heated in a Reilly Water Heater. The water does not come in contact with the steam and the patented Reilly construction prevents contamination by steam leakage. These heaters are, therefore, particularly adapted for boiler feed, process work and service in restaurants, laundries, etc.

Some of the additional advantages of the Reilly Heater that have brought about its wide popularity, are its high rate of heat transfer, simple construction, compact arrangement, negligible maintenance expense, and its interchangeable coils that can be inspected and made tight while under boiler pressure. In many installations Reilly Heaters have operated for a quarter century and more without a cent of upkeep cost.

Write for bulletin describing the Reilly Heater and explaining its many applications.

THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York City

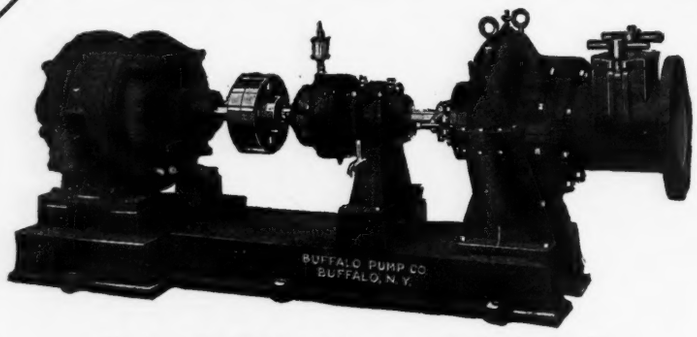
Philadelphia	Chicago		St. Louis	San Francisco
Boston	Detroit		Kansas City	Los Angeles
Rochester	Cleveland		New Orleans	Seattle
Buffalo	Indianapolis		Charlotte	Denver
Pittsburgh	Cincinnati		Houston	Tulsa
Massillon	Milwaukee		Dallas	Atlanta
	Minneapolis			Memphis

For Canada: Riley Engineering & Supply Company, Ltd., Toronto

Griscom-Russell

Heat Transfer Apparatus

Wherever Pumps are Subjected to Unusual Service



Horizontally Divided Casing . . . Single Suction Type Non-Clogging Pump . . . Motor Driven

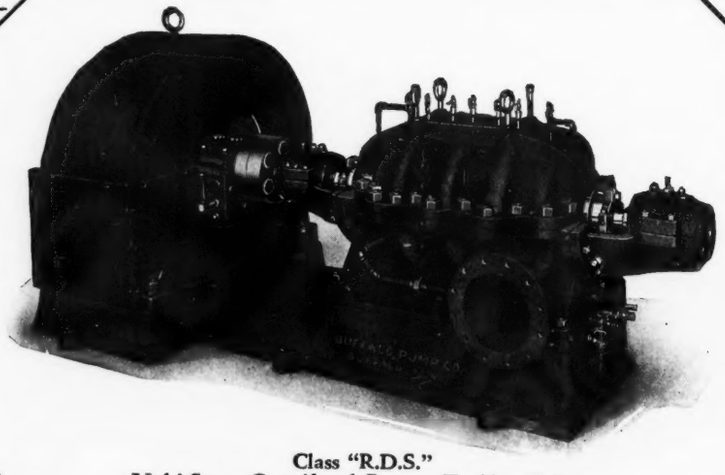
or wherever New conditions and New requirements call for New developments—
Let "BUFFALO" Engineers make their recommendations.

AT YOUR SERVICE WITHOUT CHARGE

Buffalo Non-Clogging Pumps are built in several different types, making possible the choice of the one that fits certain particular conditions.

Single suction with horizontally divided casing—Single suction with solid casing and removable side plates—Double suction with horizontally divided casing—and Single suction "raw sewage" type to handle extremely large solids.

Specially designed non-clogging impellers (patent applied for) are used for heavy, stringy or lumpy liquids.



Class "R.D.S." Multi-Stage Centrifugal Pump—Turbine Driven

In every power plant there is some problem where the right pump means lower operating costs, or fewer breakdowns, or a more uniform product. Buffalo engineers can help you solve it. Nearly a half a century of pump building has given us the answers to many questions.

ASK BUFFALO

Branch offices in all principal cities

BUFFALO STEAM PUMP COMPANY

488 Broadway **Buffalo, N. Y.**

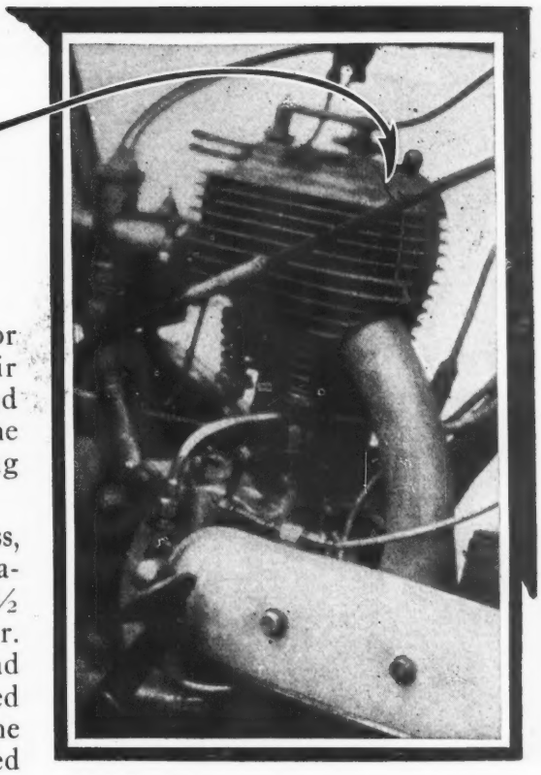
In Canada
Canadian Blower & Forge Co. Ltd.
Kitchener, Ont.

"Buffalo"

Steam Pumps—Centrifugal Pumps—Power Pumps—Special Pumps

This SMOOTH-ON repair

defied shock, vibration, intense heat on one side and intense cold on the other



CRACKS in air-cooled cylinders of motor cycle engines are exceptionally hard to repair because of the vibration, the ferocious pressures and temperatures of the internal combustion, and the cold outside blasts of biting winds when traveling at high speeds in winter.

Henry J. Sales of 16 Waller Road, New Cross, London, England, had a powerful one-cylinder machine with engine compression ratio of about 4½ to 1 and capable of a speed of 50 miles per hour. When a crack developed in the cylinder head and extended through the exhaust port, a welder asked a high price for a repair because he didn't want the job, so Mr. Sales got SMOOTH-ON No. 1, pounded a small quantity into the crack and produced a seal that made the cylinder strong as new. He first convinced himself of the strength of the repair by making a stiff test on the worst hill in his neighborhood, and he reported to us only after 1,000 miles of subsequent service. At that time, the SMOOTH-ON was still successfully defying the destructive influences and appeared to be able to do so indefinitely.

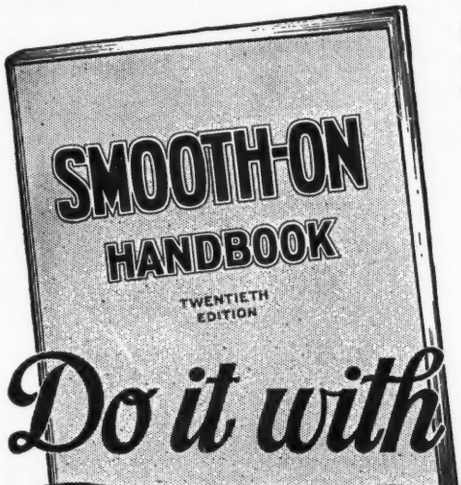
The ability of SMOOTH-ON No. 1 to make such a showing is proof of equally good performance under the less trying requirements of steam engine, pump, air compressor or pipe line repairs and pressure joints.

The SMOOTH-ON Handbook is filled with practical suggestions for stopping all kinds of leaks that an Engineer encounters.

Get your copy by returning the coupon, and get SMOOTH-ON *No. 1 in 1 or 5-lb. can or 25, 50 or 100-lb. keg from your supply house or if necessary, direct from us.*

The SMOOTH-ON HANDBOOK FREE if you return the coupon

Twentieth Edition — 136 pages of data — 193 diagrams, pictures and practical hints on at least 200 different uses for SMOOTH-ON. Every progressive engineer should have this book—get your copy NOW.



SMOOTH-ON MFG. CO.,
Dept. 30, 570 Communipaw Ave, Jersey City, N. J.

Please send copy of the SMOOTH-ON HANDBOOK, 20th Edition.

Name .....

Address .....

.....

6-25-29

Do it with SMOOTH-ON

CHARLES A. COFFIN MEDAL
FOR DISTINGUISHED CONTRIBUTION TO THE DEVELOPMENT OF ELECTRIC LIGHT AND POWER FOR THE CONVENIENCE OF THE PUBLIC AND THE BENEFIT OF THE INDUSTRY AWARDED TO
EL PASO ELECTRIC COMPANY
1928

THE CHARLES A. COFFIN MEDAL

THIS medal, awarded annually, is the highest recognition of accomplishment that can come to a public utility company.

In eight years it has been won four times by companies under the Executive Management of Stone & Webster, Inc.

NORTHERN TEXAS TRACTION COMPANY
PUGET SOUND POWER & LIGHT CO.
VIRGINIA ELECTRIC AND POWER COMPANY

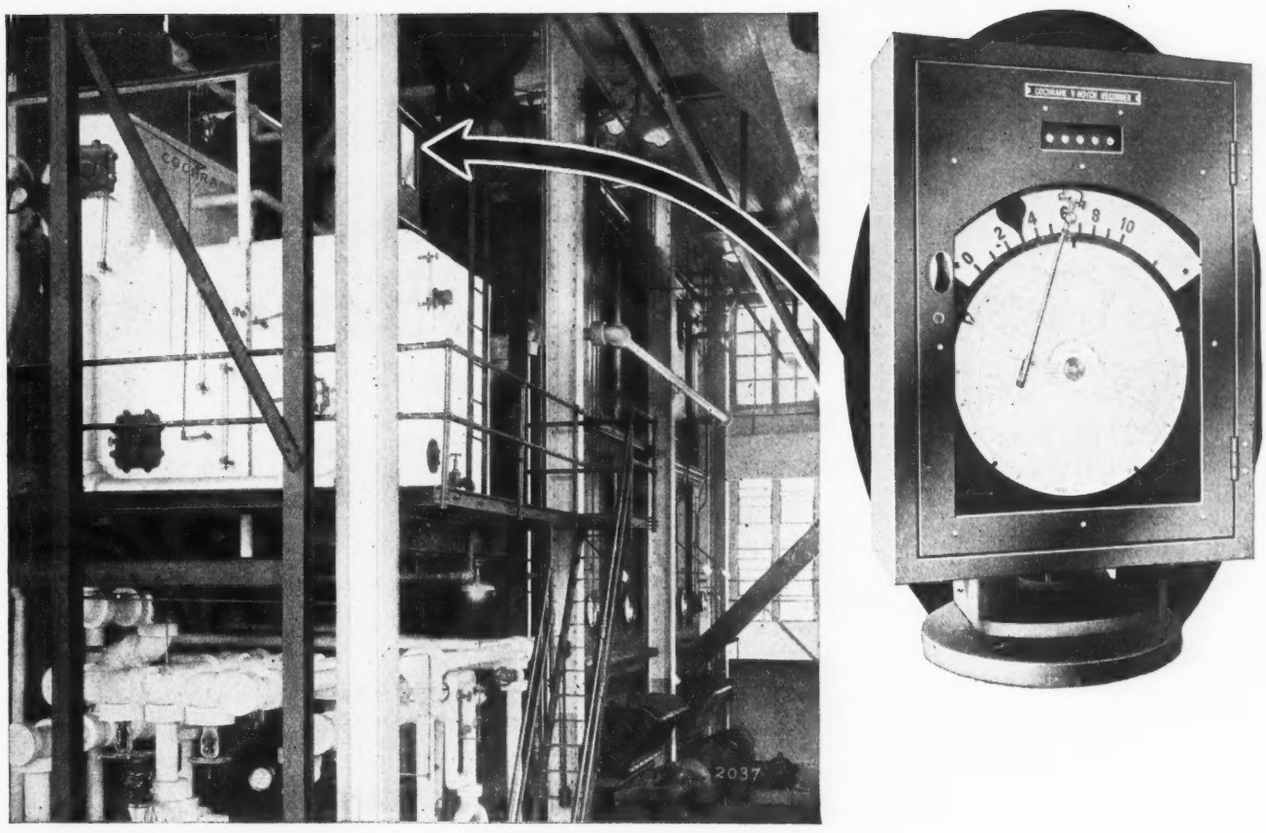
And now it's the EL PASO ELECTRIC COMPANY

"which by its initiative, skill, and enterprise has during the year 1928 made a distinguished contribution to the development of electric light and power for the convenience of the public and the benefit of the industry."

STONE & WEBSTER

INCORPORATED

OPERATE FINANCE BUILD



Importance of Keeping A Record of OUTPUT vs. INPUT

THE boiler room of the water works pumping station here shown is equipped with a Cochrane Metering Heater, which measures the amount of feed water, while at the same time utilizing the exhaust steam to heat the water.

The comparison of total feed water with total fuel is a measure of boiler efficiency, and can be used for comparing the relative values of different grades of fuel or the effectiveness of different methods of firing or of different ways of controlling draft, etc. The daily records of the boiler feed water meter serve to detect any departure from the average, due to changes in fuels, in methods or in equipment.

Similarly, the comparison of the total water evaporated with the total pumpage of the station, as shown by flow meters in the delivery lines from the pumps, will measure the overall duty of the station in transforming steam produced into useful work done; in other words, duty in foot pounds per thousand pounds of steam.

In the water works pumping station, fuel costs are the principal expense and any improvements resulting in their reduction become a continuous source of saving. Even small savings, continuously accumulated, in time pay for improved equipment or for closer attention to operation. Frequently improvements in methods can be made which really cost nothing at all but which result in considerable economies.

We are printing a series of leaflets on ways of using Cochrane V-notch Meters and Cochrane Flow Meters to improve plant economy and would be glad to send you a set if you will give us your name and address.

COCHRANE CORPORATION

17th and Clearfield Streets, Philadelphia, Pa.

466

"A Fair Offer"—— George Edwards—Engineer

"The caption of an advertisement in this week's POWER entitled 'This Trap Can't Sue for Non-support' certainly caught my attention!

"To begin with it struck me as being as fair an offer as it would be possible for a manufacturer of this type of equipment to make.

"After stating what this trap could normally be expected to do as far as discharging condensate, sludge, gases and entrained air; and indicating the high pressure and temperature limits of operation, an offer is made to send as many traps as you require for a ninety day trial—without cost or obligation.

"Something about that proposition excites a considerable amount of admiration for the policy and respect for the product.

"Here we have a manufacturer who believes that his product has been built in such a way that by its performance it can sell itself. One who is willing to go even further and to allow you to test the worth of his product by operating under *your* service conditions for ninety days; without reservation as to conditions, or cost or obligation to you—confident that the trap will sell itself on a performance basis.

"In my opinion the Chief Engineers of plants contemplating new or renewal installations of this type of equipment that don't take advantage of this offer will be passing up a real opportunity.

"Another thought that came to me was suggested by the non-support idea in this same advertisement.

"The machinery and equipment we install in our plants 'can't sue for non-support' even in those plants where, once installed, they are forgotten forevermore.

"There are, regrettably, many plants in which fine and costly installations of machinery and equipment are made only to be neglected ever after. Where overhaul and maintenance only follow after a complete breakdown.

"Even in these plants the Chief can't be sued for non-support but some day, somewhere, the pitiable condition of plants such as these will become evident and stand as a glaring indictment of some one man.

"Because our equipment can't sue should be added reason for all of us to keep our plants in the best possible condition; a double obligation to the company and to the equipment, both demand it. It should be the boast of each of us that his plant is in the best operating condition possible.

"Give the maximum 'support' and care to your plant and your plant will give the best possible support to you."

Are you troubled with seepage water?

Have you a basement below sewer level . . . or an elevator sump, scale pit, piping tunnel, etc., that accumulates water by seepage, and drainage? Then you will be interested in the Penberthy Pumps pictured here.

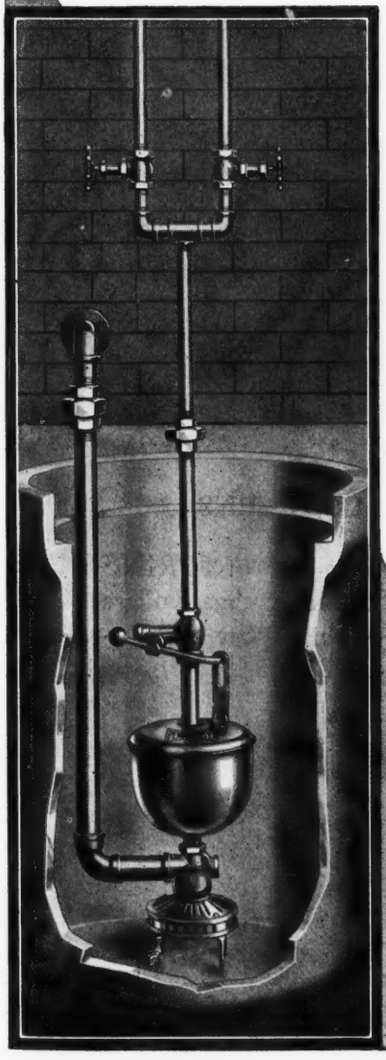
Penberthy Pumps will keep dry the places that cannot be drained directly into the sewer.

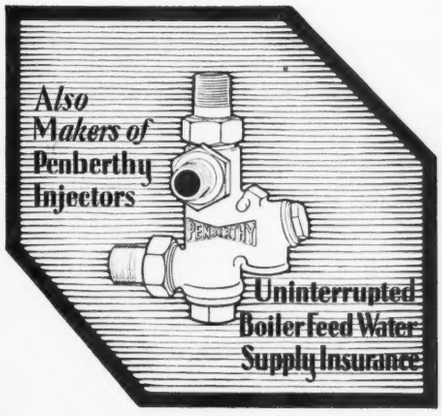
PENBERTHY PRODUCTS

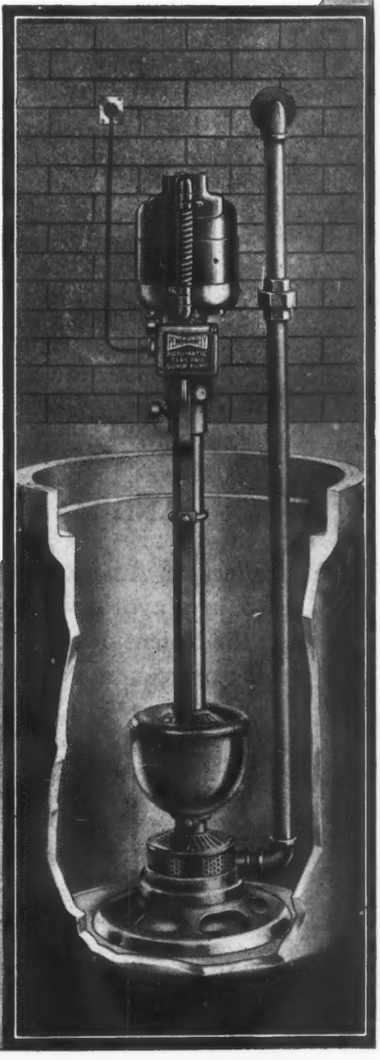
These pumps are completely automatic in operation; when installed . . . and installation is easy . . . they require no attention. They are ruggedly built of copper and bronze so that they are dependable and impervious to rust.

The Penberthy Pump shown at the left is operated by either steam or water pressure. When the steam pressure is down, the change to water operation is instantly made by simply closing one valve and opening another. The electrically operated unit is shown below at the right. The operating cost of both types is very small.

Penberthy Pumps are carried in stock by leading jobbers throughout the country. Write us for capacities, specifications and installation drawings . . or see your plumbing contractor.







PENBERTHY INJECTOR COMPANY

DETROIT

ESTABLISHED IN 1886

CANADIAN PLANT WINDSOR, ONT.

SINCE 1890

SPRINGFIELD BOILERS

Have enjoyed a continually increasing list of satisfied users the WORLD over.

In the largest and most notable Central Stations as well as Power Plants serving Industries of all kinds.

Below are a few of the prominent users of SPRINGFIELD BOILERS in Industrial Plants:

Anheuser-Busch, Inc., St. Louis, Mo. and Richmond, Va., plants
Standard Oil Co., Carlinville, Ill.; Brooklyn, N. Y.; Bayonne, N. J. and South American plants
Deere & Co., Waterloo, Iowa; Moline, Ill. and East Moline, Ill., plants
Anaconda Copper Mining Co., Cananea, Sonora, Mexico
Delco-Remy Corp'n., (General Motors Corp'n.,) Anderson, Ind.
Studebaker Corp'n., South Bend, Indiana
Ford Motor Co., (Fordson Coal Co.,) Twin Branch, W. Va.
Otis Elevator Co., Harrison, N. J. and Yonkers, N. Y., plants
Caterpillar Tractor Co., Peoria, Ill.
American Bemberg Corp'n., Elizabethton, Tenn.
American Metal Co., Mapimi, Durango, Mex. and Glorietta, N. M., plants
National Carbon Co., Fostoria, Ohio
Bush Terminal Co., Brooklyn, N. Y.
Liggett & Myers Tobacco Co., Durham, N. C.
Western Cartridge Co., Alton, Ill.
Atlantic Ice & Coal Corp'n., Nashville, Tenn.; Tampa, Fla. and Columbus, Ga., plants
Youngstown Sheet & Tube Co., Youngstown, Ohio
Standard Paper Co., Kalamazoo, Mich.
Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
National Tube Co., Lorain Works, Lorain, Ohio
John Deere Harvester Works, Moline, Ill.
Brown & Williamson Tobacco Co., Louisville, Ky.
Armour & Company, Kansas City, Kans.
M. W. Kellogg Co., Jersey City, N. J.
Illinois Glass Co., Bridgeton, N. J.
White Star Refining Co., Trenton, Mich.

AND MANY OTHER PROMINENT INDUSTRIAL CONCERNS

When leaders of American Industry, convinced by the satisfactory performance of SPRINGFIELD BOILERS, are favoring us with many REPEAT ORDERS—can you afford to purchase boilers without obtaining the benefit of our long experience and our Engineering Staff? Tell us your Boiler problems. Our catalog on request.

Repeat Orders Constitute the Larger Part of Our Business

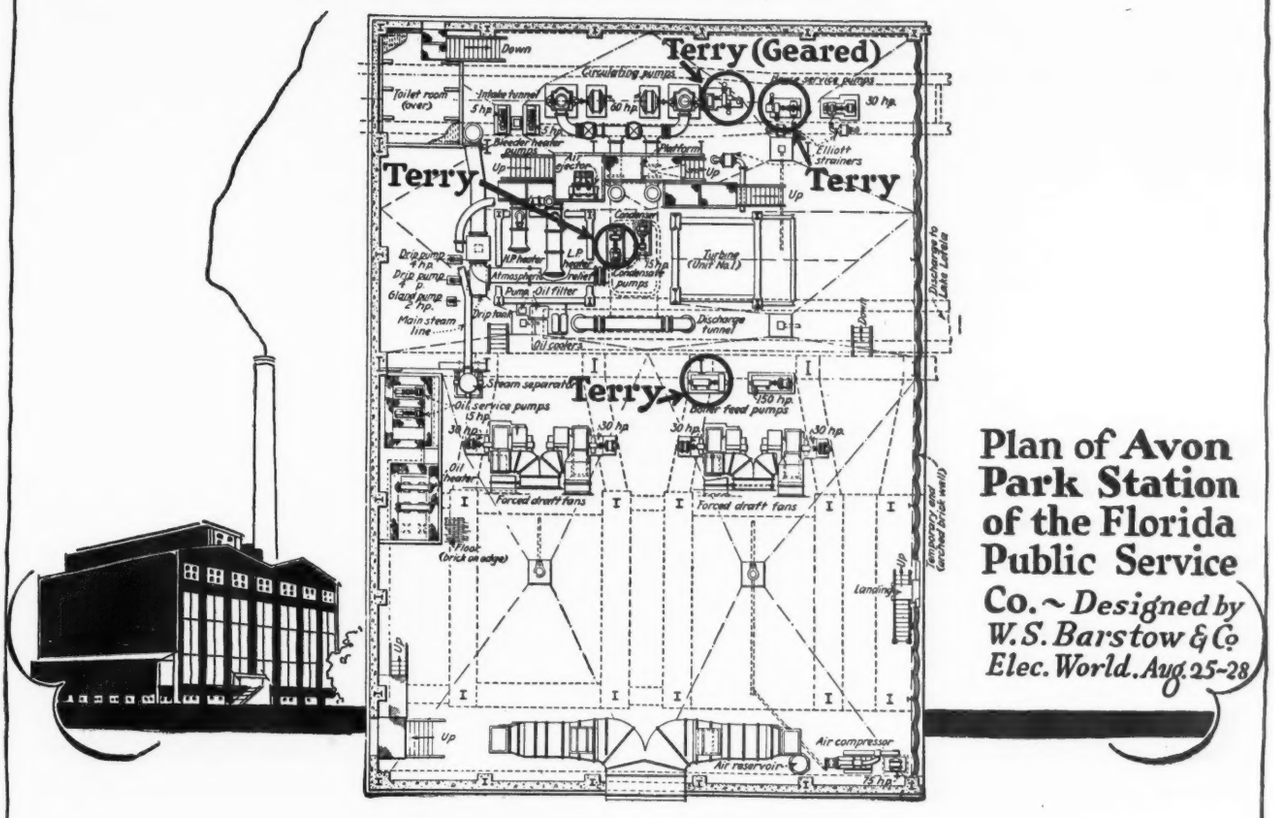
SPRINGFIELD BOILER CO.

SPRINGFIELD, ILLINOIS

OFFICES:
Chicago
New York
Boston
Philadelphia
Richmond
Atlanta
Pittsburgh

OFFICES:
Cincinnati
Minneapolis
Kansas City
Dallas
Los Angeles
San Francisco
Seattle

All the Auxiliary Turbines at AVON PARK are TERRYS ~



Plan of Avon Park Station of the Florida Public Service Co. ~ *Designed by W. S. Barstow & Co. Elec. World, Aug. 25-28*

One of the most remarkable features of this new 15,000 kilowatt central station of the Florida Public Service Company is the fact that it can be actually operated by one man.

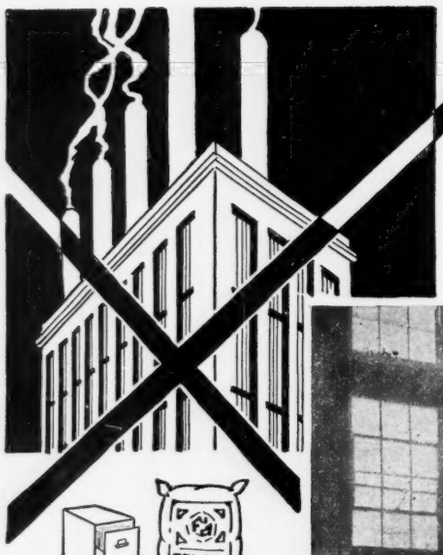
To make it possible for one man to handle the entire station, simplicity and reliability were made the key-notes in the design.

Dependable Terrys were, therefore, the logical choice for the auxiliary turbine drives.

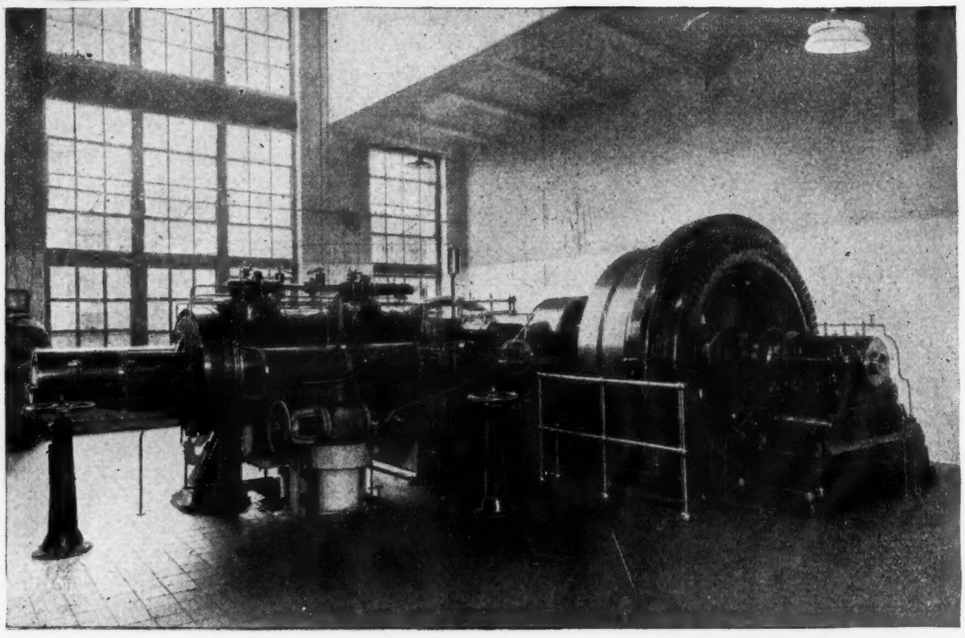
The Terry Steam Turbine Company

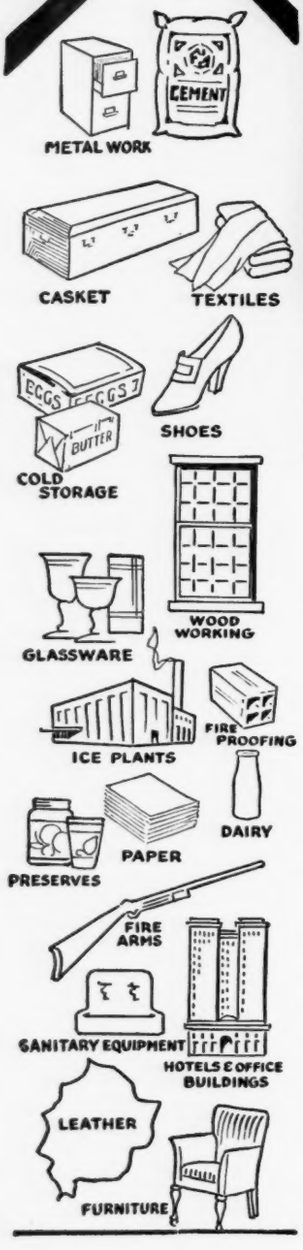
TERRY SQUARE, HARTFORD, CT.
OFFICES IN PRINCIPAL CITIES
Steam Turbines + Gears + Shaft Couplings

T-1026



We have done it for others We can do it for You





The Skinner "Guaranteed Saving Contract"

With this contract you are enabled to install your own power plant without tying up a large amount of working capital. It is only necessary to make a part cash payment and let the engine pay the balance in the savings effected against your former power bills.

Every one of these industries has at least one plant that is operating under its own power that is made by "Universal Unaflow" engines installed under the "Guaranteed Saving Contract" plan.

We usually find that the savings to be made in the power-generating department exceed the percentage of profits made by any other department in the plant. We can, upon your request, cite specific installations similar to yours and show the savings made in these plants. We can prove that the "Universal Unaflow" is the most economical steam engine ever built.

Without any obligation on your part, let us show you how much we are able to save you with a "Universal Unaflow."

"The Most Economical Steam Engine Built"

THE "UNIVERSAL UNAFLOW"

WRITE FOR YOUR COPY

BUILT ONLY BY **SKINNER ENGINE CO., ERIE, PA.**

Branch Offices in all Principal Cities

OFFICE MEMO

I think we should look into the attached. I understand that these blowers are being used by such concerns as:

Anaconda Copper Mining Co.
Carnegie Steel Co.
Commonwealth Edison Co.
Southern California Edison Co.
William Arnot, Ltd.,
Sydney, Australia
Synthetic Ammonia & Nitrate Co.
Stockton, England
Linchow Electric Light Co.,
China
H. Zegielski,
Poland
Gramaphone Company,
Middlesex, England

BAYER SOOT BLOWERS

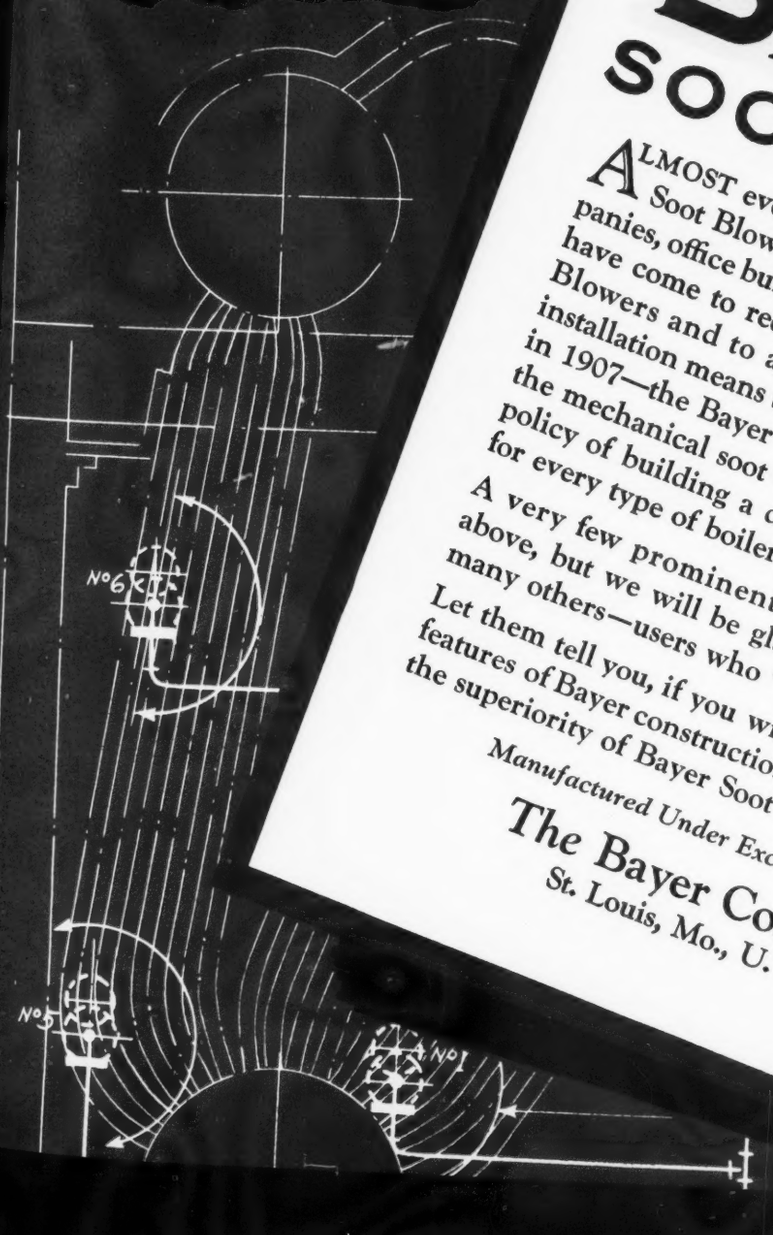
ALMOST everywhere you will find users of Bayer Soot Blowers. Industrial plants, steamship companies, office buildings and institutions the world over have come to recognize the efficiency of Bayer Soot Blowers and to appreciate the saving which their installation means to them. For—since its organization in 1907—the Bayer Company has stood at the head of the mechanical soot blowing industry, maintaining a policy of building a distinctive soot blowing system for every type of boiler.

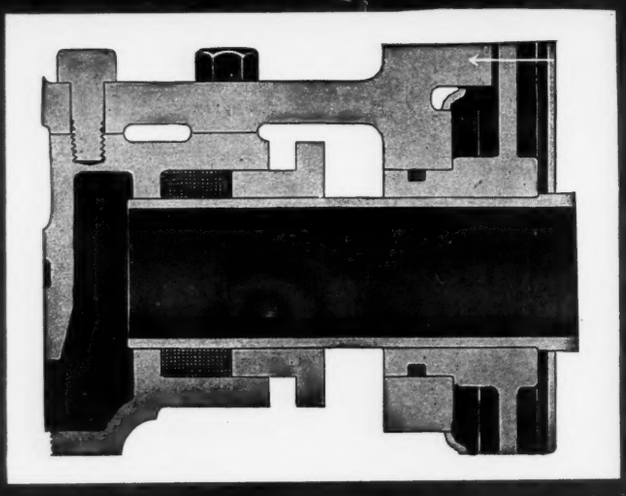
A very few prominent installations are mentioned above, but we will be glad to give you the names of many others—users who "know".

Let them tell you, if you wish, of the many exclusive features of Bayer construction which best demonstrate the superiority of Bayer Soot Blowers.

Manufactured Under Exclusive Patents by

The Bayer Company
St. Louis, Mo., U. S. A.





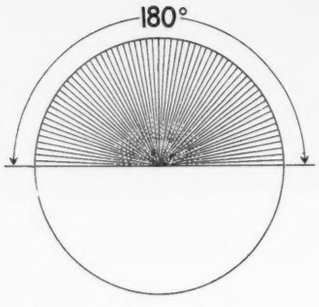
BAYER
SOOT BLOWERS

FULL blowing force properly directed without loss of steam, that means thoroughly cleaned boiler tubes and an economy of operation which none but a Bayer Soot Blower can effect.

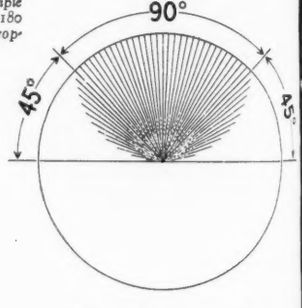
The Bayer Master-Model K-2 is designed on the basic principle of balanced valve-in-head construction. This assures balanced valve action entirely independent of the rotation of the blower element and insures 100% cleaning efficiency. The manual effort required to operate is reduced to a minimum through a Bayer feature of construction which allows the head to operate in either direction.

Completely encased gears, a full floating head, lateral adjustment control, roller thrust bearings, air-cooled non-oxidizing non-warpable Chromite elements—these are a few more exclusive Bayer features which so prominently distinguish Bayer Soot Blowers from others of the valve-in-head type. No other soot blower made offers such reliable service, economy and ease of operation and such obvious superiority in its field.

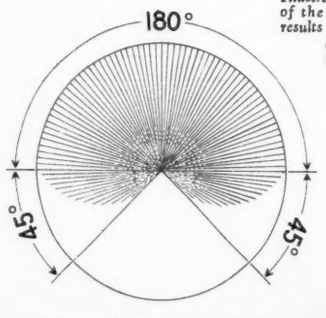
And remember—the Bayer Company builds a distinctive soot blowing system for every type of boiler.



Illustrating the Bayer principle applied to an arc-of-blow of 180 degrees—full blowing force properly directed and 100% cleaning efficiency.



Illustrating the percentage of efficiency of the ordinary soot blower and the results obtained when the valve is controlled by the same means that rotate the blower element.



Illustrating the loss of steam when an attempt is made to produce a full 180 degree arc-of-blow with an ordinary soot blower.

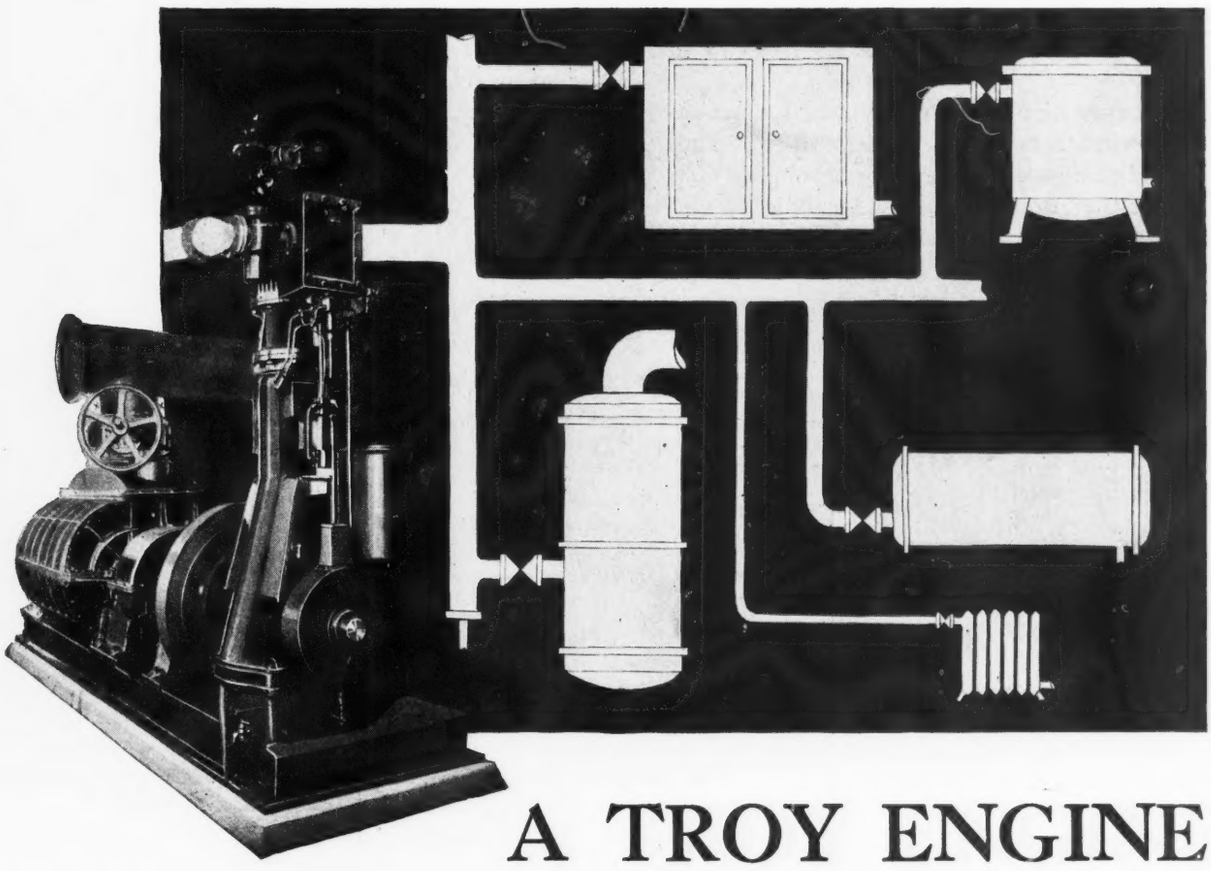
BAYER for every type of boiler

The Bayer Company

1504 South Grand Boulevard • • St. Louis, U. S. A.

Bayer Soot Blower Co., Ltd. • Lloyds Bank Chambers, 125 Balham High Rd. London S. W. 12, England.

PUMPING and HEATING



A TROY ENGINE
Furnishes both Power and Heat

To builders of steam-engine-driven machines:

Our concentrated production on Steam Engines exclusively enables us to supply you with efficient, reliable units at lower prices than your own costs in many cases. Let us operate as a department of your own plant, taking the steam engine problem off of your hands. Estimates submitted promptly.

Low pressure steam is the main source of heat for industrial plants. With a Troy Engine boiler steam at 100 to 200 lb. pressure is exhausted at 10 to 15 lb.—thus low pressure steam is obtained for heating, drying, and other processes requiring heat. In this way efficient mechanical power is secured for driving, pumps, blowers, etc., at practically no additional cost.

Other advantages of Troy Engines are:

Working parts entirely enclosed.

Automatic lubrication

Special valve action.

Troy Engines can be supplied up to 250 hp.—vertical or horizontal.

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TROY, PA.

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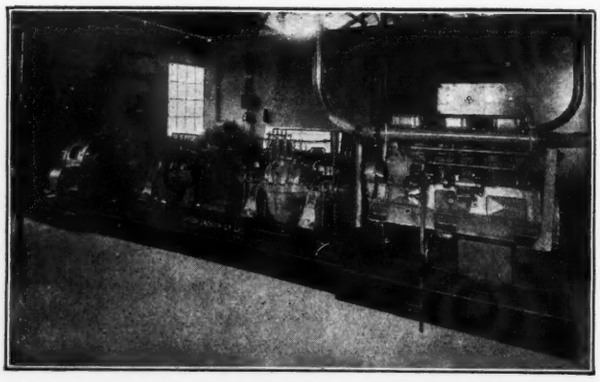
HOW MANY STORMS
Can A Power Line Weather?

Copper wire stretches. Whipped about in the wind, seasonably coated with sleet and ice; 3 years are sufficient to warrant renewal. After that, breakage may suddenly leave you without power for water or lights,—unless you have

Sterling High Duty Internal Combustion Engine



Fire Foam pumping unit, Byron Jackson pumps in tandem at Pan American Petroleum Co., Los Angeles, Cal. These pumps require 156 H.P. at 1300 R. P.M., Sterling 6 cylinder 200 H.P. for emergency drive.

12 to 565 B.H.P. Gas or gasoline.

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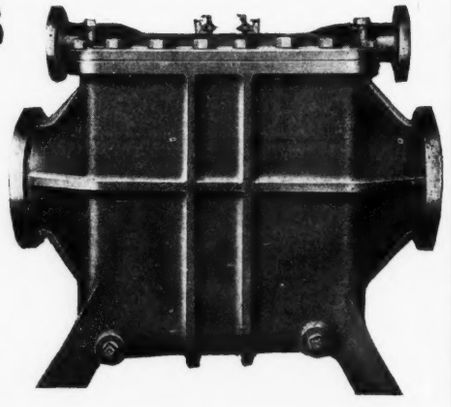
S & K AFTER-COOLERS
do double duty: they cool the air and remove the moisture

Recommended where compressed air is used for paint sprayers, pneumatic tools and other machinery.

12 standard sizes—Capacities 100 to 4000 C.F.M.



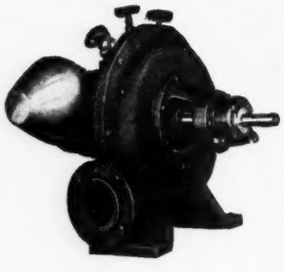
SCHUTTE & KORTING

Bulletin 12-G contains interesting data on cooling compressed air

1150 Thompson St., PHILA., PA.

Steam Turbines

1 to 60 H.P.



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PENNSYLVANIA

Air Compressors and Centrifugal Pumps For Every Purpose

PENNSYLVANIA PUMP and COMPRESSOR CO.
Main Office and Works, Easton, Pa.

Falls Engine Stop

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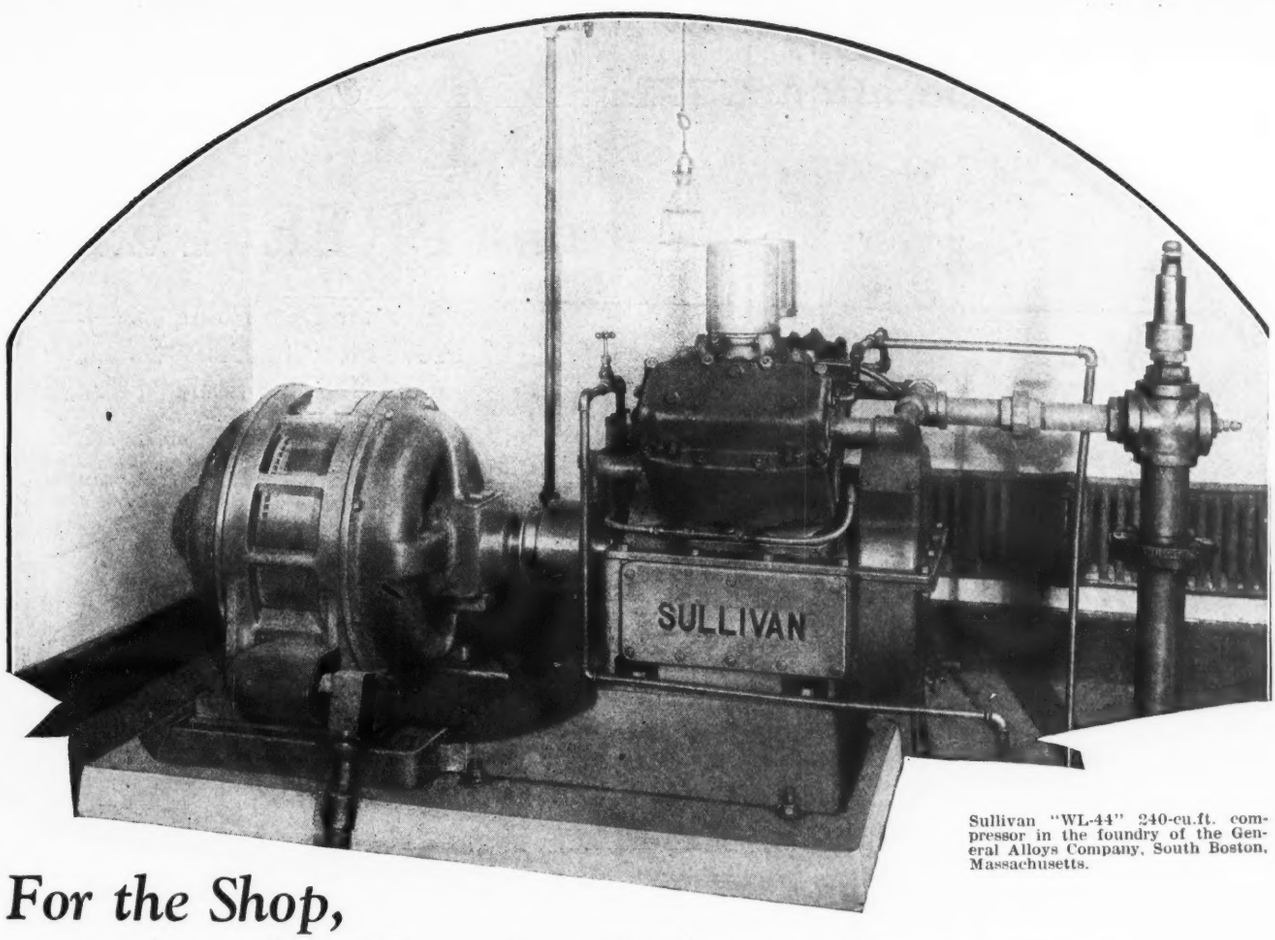
Natural Gas and Blast Furnace Gas Burners
GAS COMBUSTION CO., Pittsburgh, Pa.



Sullivan "WL-44" 240-cu.ft. compressor in the foundry of the General Alloys Company, South Boston, Massachusetts.

For the Shop, Another Popular Sullivan Compressor

direct connected—automatic—compact

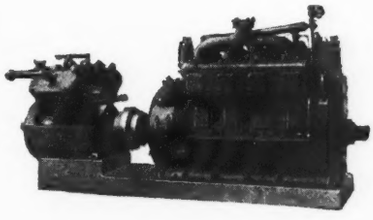
Sullivan vertical compressors have had a rapid run to popularity.

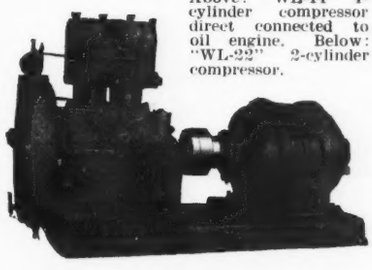
Originally designed for small shops, isolated departments, or for standby or night service—these compressors have been adopted by large and small plants for a variety of services.

The picture above shows a Sullivan 4-cylinder vertical compressor at work in the plant of the General Alloys Company, South Boston Massachusetts.

Here it supplies air power for chipping, grinding, hoisting, and other general foundry operations, in making Q-Alloy and X-ite for Ford Motor Company, General Motors Corporation, International Harvester Company, and many other world known establishments.

Compactness, automatic control, direct motor or oil engine drive, and semi-portability, are some of the advantages of these Sullivan Vertical Compressors.





Above: "WL-44" 4-cylinder compressor direct connected to oil engine. Below: "WL-22" 2-cylinder compressor.

The "WL-44" is a "Balanced V" 4-cylinder machine, available in capacities of 240, and 350 cu. ft. of air per min. "WL-22" has two vertical cylinders, and capacities of 120 and 175 cu. ft.

Wafer valves, sweep-control unloading, automatic lubrication, and full water cooling of cylinder barrels and heads, are features which improve the economy of these machines. Compressor and engine are rigidly mounted on a cast iron base.

Sullivan Air Compressors can be had in many sizes, of single and two stage, belted and direct connected machines, with capacities from 68 to 5100 cu. ft. per min.

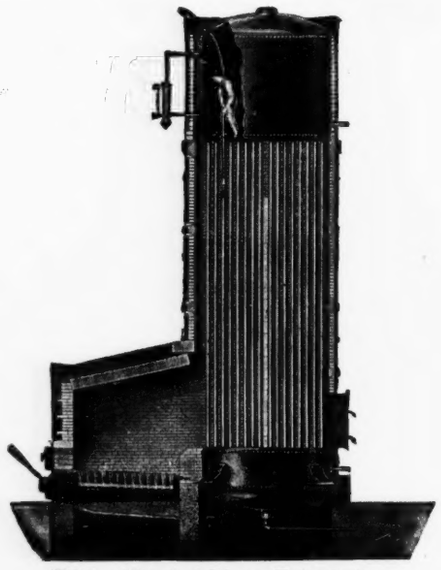
Send for Catalogs

S U L L I V A N TRADE MARK

Sullivan Machinery Company

800 Wrigley Bldg., Chicago

THE PROBLEM of Steam Generation



Wickes Vertical Water Tube Boiler

THE WICKES VERTICAL WATER TUBE BOILER fulfills the requirements of certain plants as no other boiler can.

There are reasons for its superior adaptability to many and various specific needs.

These reasons have been borne out over a long period of years and attested by the use of over a million horsepower.

In the problem of steam generation, careful boiler selection is necessary to insure low cost of steam production.

Prospective purchasers will be well repaid in ascertaining the facts by thorough investigation.

THE WICKES BOILER CO.
Established in 1856
Saginaw, Mich.

SALES OFFICES:
New York, 501 Fifth Ave. Pittsburgh, 1218 Empire Bldg.
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Make this FREE TEST

In Your Own Plant, Prove How the DEAN Gets *ALL* the Scale

TO every power plant operator, we offer a free test of a Dean Boiler Tube Cleaner on any one boiler. Operators of the most modern high pressure boilers, including those who have been using other cleaning methods, are particularly invited to make this test. The additional 200 to 1000 pounds of scale that the Dean frequently dislodges is proof of its effectiveness.

A Dean gets *all* of the scale. Every 1000 pounds of this removed scale saves 25 tons of coal per month. Small wonder that we guarantee to every purchaser that a Dean will pay for itself in six months time or less, or your money will be cheerfully refunded.

Tell us the type of boiler on which you will test a Dean, also the size of the tubes. We will promptly ship you a Dean without cost and with no obligation to buy. Try it out. Weigh the scale it removes. And if you don't find that it dislodges more scale quicker and easier than by any other method you ever tried, just send it back. Let this free demonstration prove the superiority of the Dean to you.

Wm. B. Pierce Company
Frankling Bldg., Buffalo, N. Y.

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Water Tube Boilers for Every Service

BOILERS of high quality for central stations and industrial plants of all sizes, and for utilization of waste heat from kilns and furnaces. Steel construction only. Straight tube and bent tube types. Noted for long life and economy of operation.

Engineering service available—wire or write.

EDGE MOOR IRON COMPANY **Edge Moor, Delaware**

EDGE MOOR Water Tube BOILERS

STRAIGHT AND BENT TUBE TYPES—WATER WALLS—AIR PREHEATERS

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STEAM TURBINES
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MOORE STEAM TURBINE CORPORATION
Wellsville, N.Y.
"BEST AT EVERY TURN"

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Steam Turbines, for all speed and steam conditions; capacities up to 15,000 Hp. Catalog D-40. **Double Helical Speed Reducing Gears.** Catalog R-40. **Centrifugal Pumps,** for all capacities. Catalog B-40. **Centrifugal Blowers and Compressors.** Catalog F-40. **Worm Reduction Gears.** Catalog R-40. **Flexible Couplings.** Catalog K-40. **Water Wheels.** Catalog T-40.

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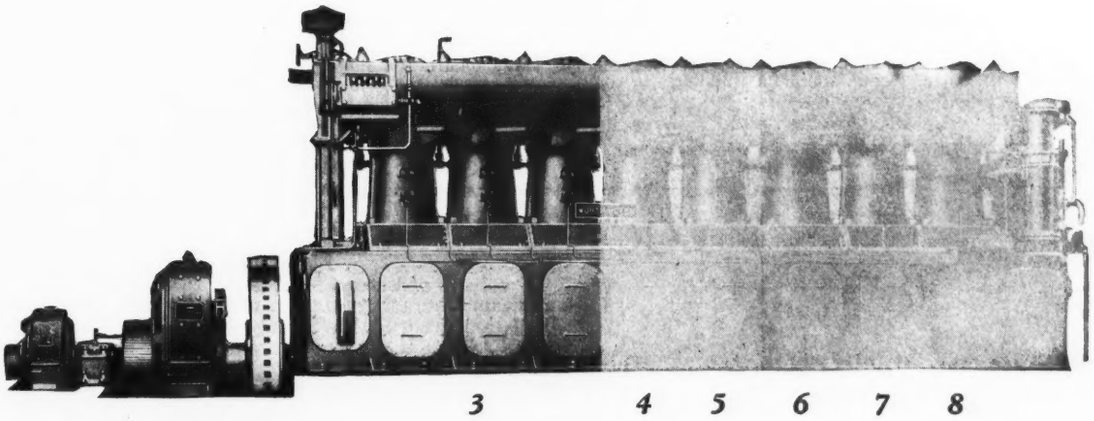

3 4 5 6 7 8

of Diesel Engine...will serve YOU most effectively?

YOU can obtain the standard Worthington four-cycle air injection Diesel engine in 3-cylinder to 8-cylinder sizes... 300 to 900 h. p.... to suit your individual requirements.

This engine is of the vertical, slow speed, heavy duty, single-acting type. It has a more conservative rating, lower rotative speed and greater weight per horsepower than any similar engine manufactured in the United States.

Produced by an organization which has had over 32 years experience in building internal combustion engines, this engine is being used as a prime mover by more than a score of widely divergent industries. It has materially reduced power costs for more than 600 users.

Here is a modern engine built to standards that assure a long life of reliable service. It is a time-proven member of the Worthington family of Diesels, which includes also two-cycle engines of both single-acting solid injection and double-acting air injection types.

May we send a competent engineer to study your needs and give you definite information on Worthington's ability to meet them? Descriptive literature will be sent upon request.

WORTHINGTON

PUMPS
COMPRESSORS
CONDENSERS *and* Auxiliaries
DIESEL ENGINES
GAS ENGINES
FEEDWATER HEATERS
WATER, OIL *and* GASOLINE METERS

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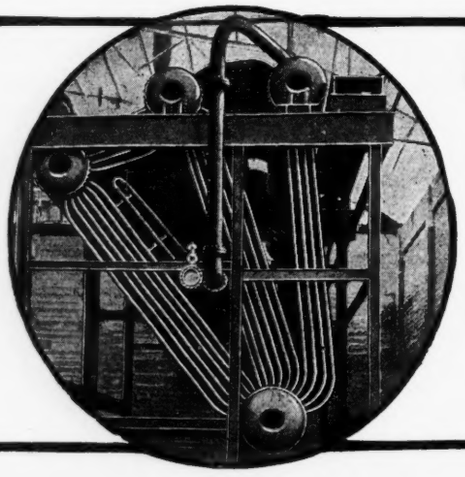

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LARGE volume of water, liberal steam space, abundant steam liberating surface and unrestricted circulation mean high efficiency, large overload capacity and minimum repairs to Connelly Boiler users. The catalog explains these features in detail—will show you how you can save money in your boiler room.

{Built in units from 200 to 4300 H.P. and for steam pressures up to 450 lbs.}

The CONNELLY BOILER COMPANY Cleveland, Ohio

Boiler Specialists for 54 Years.

CLEAN YOUR BOILERS by MODERN METHODS with DIAMOND SOOT BLOWERS

DIAMOND POWER SPECIALTY CORPORATION-DETROIT

BITUMASTIC

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SOLUTION
the ideal paint for

steel stacks, breechings, boiler fronts, pipes, cooling towers, air ducts, turbines, fans, etc.

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WAILES DOVE-HERMISTON CORPORATION
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All Steel Sectional Water Tube Boilers

A design and construction that has proved its high efficiency under all steaming conditions. Also builders of horizontal and vertical Unaflow Engines and all types of Centrifugal Pumps. Write for Catalog.

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WATER TUBE BOILERS

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LONG DRUM
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BENT TUBE

BOILER TUBES

STRAIGHT and Bent Boiler Tubes accurately fabricated to your specifications. Large capacity. Skillful Workmanship. Quick service on all orders.

STANDARD WIRE & TUBE COMPANY
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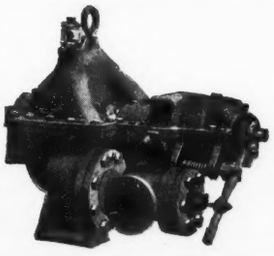
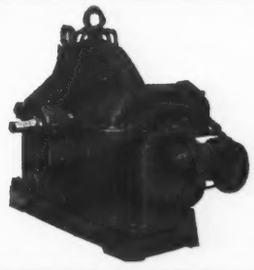
Successors to American Tube and Pipe Bending Co., The Standard Wire Co., Ridge Stamping and Fabricating Co.

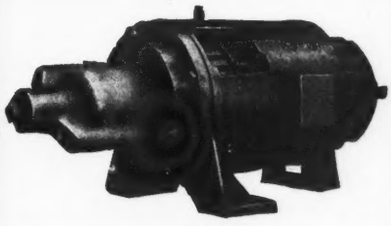
SMALL TURBINES
for Every Service



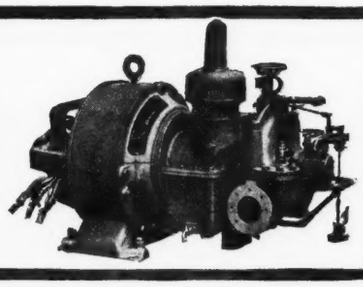
1. A 25-horsepower mechanical-drive turbine



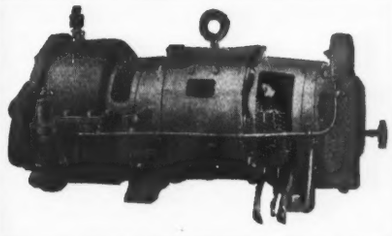
2. 150-horsepower mechanical-drive turbine



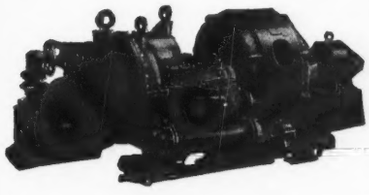
3. A kw. turbine-generator unit



4. A 25-kw. direct-current geared turbine-generator unit



5. A 10-kw. turbine-generator unit



6. A 300-kw. alternating-current geared turbine-generator unit

Whatever your requirements, they can be fulfilled by the diversified line of Westinghouse small turbines. Several types of these turbines are illustrated. Publications describing them will be sent upon request to our nearest district office.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
SOUTH PHILADELPHIA WORKS PHILADELPHIA, PA
SALES OFFICES IN ALL PRINCIPAL CITIES OF THE UNITED STATES AND FOREIGN COUNTRIES

Westinghouse

T 30520

THE LONG-REACH SOOT AND SLAG BLOWER

—is completely withdrawn from the furnace when not in use . . .

THIS Blower when in operation rests on the bridge wall and cleans soot and slag from the front of the first bank of tubes. High ratings are maintained that would otherwise be impossible. After blowing, the elements are entirely withdrawn from the heat of the furnace. The illustration shows boiler tubes in the first pass after 68 days' continuous service, operating with the LONG-REACH Soot and Slag Blower. For economy of operation and efficiency in cleaning, you can't beat the LONG-REACH.

May we send you illustrated circulars today

The ENTERPRISE MACHINE CO.
Middletown, Ohio

Four Cleanings a Year May Be Cheaper Than One

The average cleaning time per boiler is reduced by more frequent cleaning and more uniform efficiency of the boiler is maintained.

Roto 4" Heavy Duty Air-Driven Tube Cleaner

Roto Cleaners can also be furnished for various sizes and types of tubes.

THE ROTO COMPANY, Sussex Ave. and Newark St., NEWARK, N. J.

The DEMON TUBE CLEANER

For Water Tube Boilers

For fire tube boilers we make the "Torpedo."

Write for FREE TRIAL offer and bulletins.

General Specialty Co., 67 Carroll St., Buffalo, N. Y.

Lagonda Tube Cleaners

Tube Cutters, Reseating Machines

The LAGONDA MANUFACTURING CO., SPRINGFIELD, O.

LIBERTY CLEANERS

for all sizes and types of tubes

LIBERTY MFG. CO., JEANNETTE, PA.

VULCAN SOOT CLEANER COMPANY

MAIN OFFICE DUBOIS PA OFFICES IN THIRTY CITIES

Webster Bldg., DuBois, Penna.

Soot Cleaners For All Types of Water Tube and Return Tubular Boilers, Super-Heaters and Economizers.

Winners —Since 1854!

Reading Charcoal Iron Boiler Tubes have been manufactured since 1854. When you buy them, you get the proved reliability of Genuine Charcoal Iron—the one boiler tube material that resists both corrosion and vibration.

Because Reading Charcoal Iron Boiler Tubes have demonstrated their worth, time after time, you can buy them with the confidence that they will give extra years of service. Our representatives will be glad to give you complete information about Reading Charcoal Iron Boiler Tubes. Get in touch with the nearest today.

READING IRON COMPANY, Reading, Pennsylvania

Atlanta · Baltimore · Cleveland · New York · Philadelphia
Boston · Cincinnati · St. Louis · Chicago · New Orleans
Buffalo · Houston · Tulsa · Seattle · San Francisco
Detroit · Pittsburgh · Ft. Worth · Los Angeles · Kansas City

Reading Charcoal Iron Boiler Tubes are furnished in sizes ranging from 1½" to 6" in diameter

John McKenzie and Co.
Baltimore, Maryland

Williams and Co.
Cincinnati, Ohio

Williams and Co.
Cleveland, Ohio

Harrisburg Pipe & Pipe Bending Co.
Houston, Texas

Standard Supply & Hardware Co.
New Orleans, La.

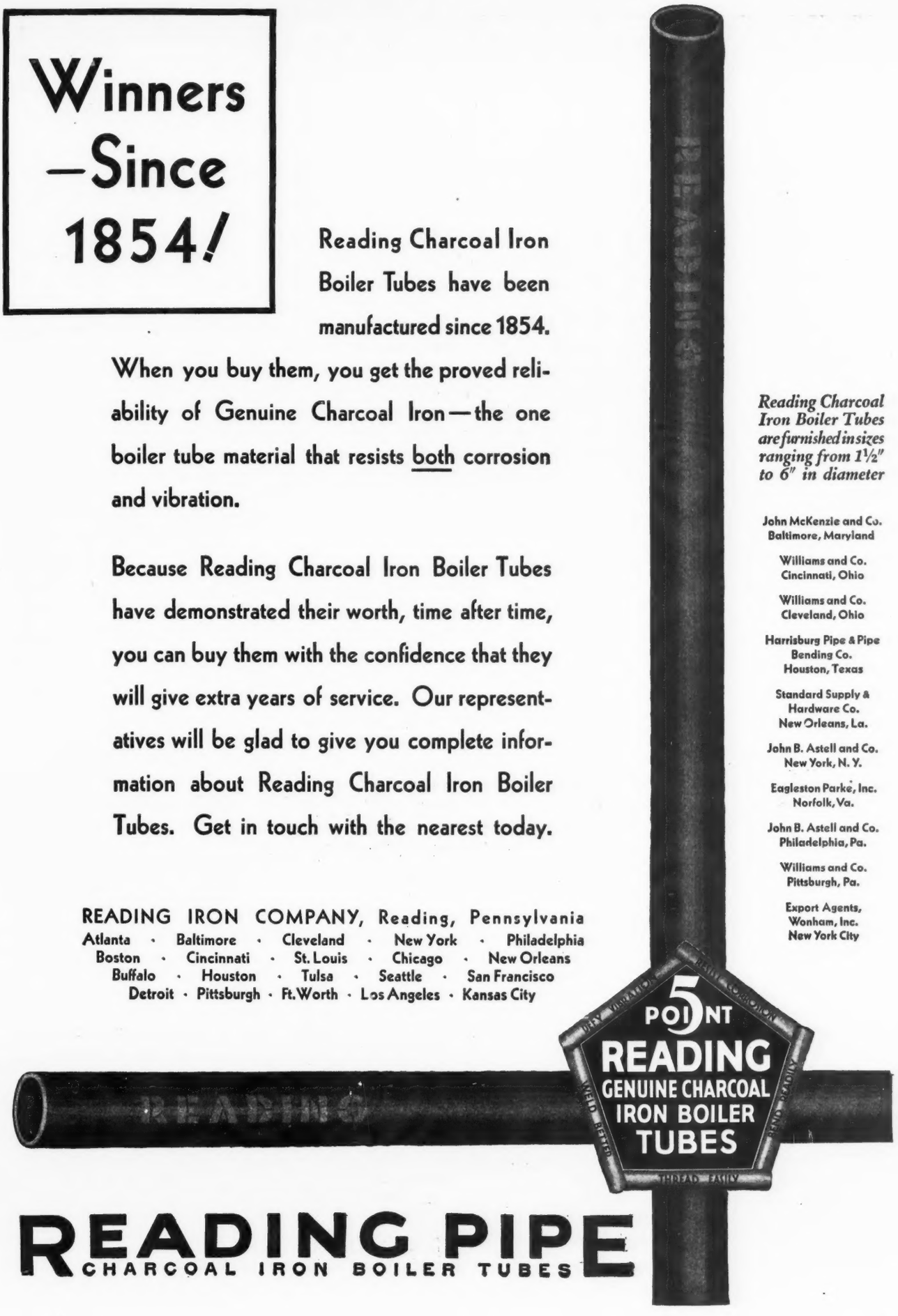
John B. Astell and Co.
New York, N. Y.

Eagleston Parke, Inc.
Norfolk, Va.

John B. Astell and Co.
Philadelphia, Pa.

Williams and Co.
Pittsburgh, Pa.

Export Agents,
Wonham, Inc.
New York City



READING PIPE
CHARCOAL IRON BOILER TUBES

WATTS REGULATORS for the BOILER ROOM

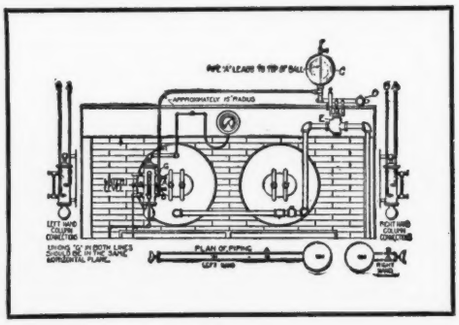
Better Steaming—

Wasteful priming and dangerous low water can be prevented—without constant attention by the operator.

The most economical water level will be held under all load changes by the

WATTS Boiler Feed Water Regulator—Type 22

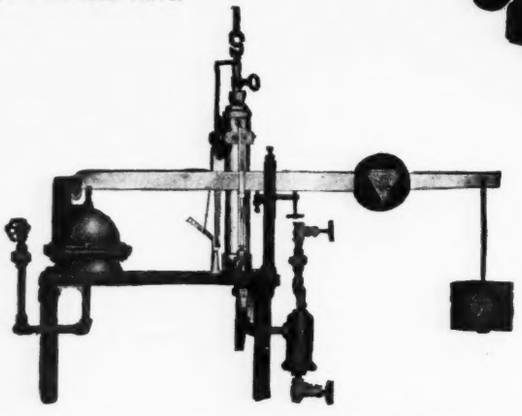
The rise and fall of water will be limited to a maximum variation of 1 in. The Watts regulator operates by gravity. The weight of water is balanced against the weight of steam. As the water rises it enters and fills the counter weighted hollow ball, causing it to gradually sink and close the feed valve. As the water level drops, the water drains from the ball back into the boiler, whereupon the counterweight gradually raises the ball and re-opens the feed valve.



WATTS Excess Pressure Pump Governor—Type 11

A necessity with any mechanical feed water regulator. It will hold a fixed pressure differential between the pump discharge and the boiler pressure. Insures more efficient pump operation and saves steam.

For vacuum pumps, we recommend Watts Vacuum Pump Governors, that are especially designed for this service. Steam pressures up to 250 lb. to hold any vacuum from 5 to 25 in.



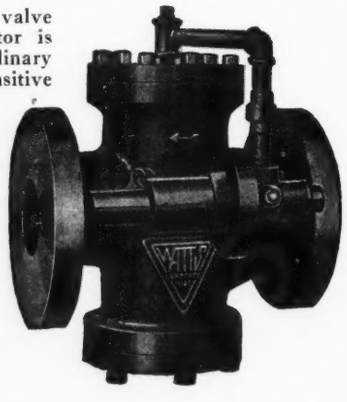
WATTS "Lawrence" Damper Regulator—Type 19

A tried and proven regulator that adjusts either individual dampers or the main damper from the steam pressure. Sensitive in operation—without lead or lag—at a few ounces difference in steam pressure. Operated by powerful double-acting hydraulic motor equipped with balanced pilot valve. Also in combination with a Watts Ported Valve it will control steam flow to fan or stoker engines or turbines or it will hold constant water level in tanks.

WATTS Auxiliary Pressure Regulator—Type 35

This self-contained, pilot valve actuated, single seat regulator is as easy to install as an ordinary globe valve. Unusually sensitive and completely dependable on intermittent or continuous service. Holds a constant reduced pressure under all conditions. Guaranteed for initial pressure of 250 lb. with a reduced pressure range of from 2 to 225 lb.

It will hold tight on dead end. Pilot valve spindle and seat are made of Monel metal and protected by a Monel metal strainer.



Watts Regulator Company
250 Lowell Street, Lawrence, Mass.

Gentlemen: Please send me a free copy of the large size **WATTS FLOW CHARTS** mounted on heavy cardboard and the new Watts condensed Catalog.

Name .....

Company .....

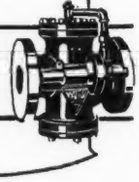
Address .....

FREE with the coupon

Large size copies of the mounted Watts Flow Charts. Indispensable to any steam engineer.

WATTS PRODUCTS

Pressure Reducing Valves
Balanced Float Valves
Feed Water Regulators
Feed Water Heaters
Pressure Relief Valves
Balance Valves
Pump Governors
Engine Regulators
Heat Interchangers
Damper Regulators



WATTS REGULATOR COMPANY
250 Lowell Street LAWRENCE, MASS.

No More Sunday Work

This chief engineer no longer works overtime cleaning boilers

The Chief Engineer of a water supply company in New Jersey operates a boiler plant consisting of 1 Erie, and 2 Babcock and Wilcox water tube boilers, totalling 435 H. P. The feed water, as obtained from their well, contains only 6 grains of hardness per gallon, but in spite of that fact the Chief Engineer writes that he formerly had "endless trouble with scale." He tried boiler compounds of all sorts, but was not successful in preventing scale or relieving the constant difficult cleaning it causes.

Previous to 1916 he had only one Erie boiler, of the three boilers mentioned above. He thoroughly investigated scale prevention and was so convinced he was on the right track that, when the two new B & W boilers went in, he also installed a Permutit Water Softener to remove all scale-forming impurities from the total feed water of 24,000 gallons per 24 hours.

Starting with 2 new boilers, he had an excellent chance to observe the work of the Softener. And this is what he writes:

> "Before installing our Permutit Water Softener (in December, 1916), we had endless trouble with boiler scale. At that time, we installed two Babcock boilers. . . Up to the present time, the Babcock boilers are *as clean as the day they were installed*. . . We have used a number of boiler compounds, but find your Softener is the only treatment that has given satisfaction. We consider this method of water softening 100% perfect."

After all these years, his boilers are as clean as the day they were installed! Think what it would mean to you to have your boilers *stay* clean.

This Chief Engineer got his original suggestions from our booklet, "Reducing Fuel and Boiler Plant Operating Costs," which contains a clear explanation of the causes of scale and how to prevent it, as well as first-hand data which we have collected from engineers in the hundreds of plants we have served.

You will find it very interesting and instructive—just mail the attached postcard today for a copy.

If you have either sea water or natural brines available, you can maintain a Permutit water softening plant without cost, as such salt solutions can usually be used to regenerate the plant.

The Permutit Company

APPARATUS FOR REMOVING IMPURITIES FROM WATER

BRANCH OFFICES IN ALL PRINCIPAL CITIES

No wonder he smiles! From one year to another his boilers require no cleaning. He is one of many fortunate engineers who laugh at boiler scale. You can do the same.

The Permutit Company

440 Fourth Ave. New York

Please send me your free booklet, "Reducing Fuel and Boiler Plant Operating Costs."

Name ..... *Position* .....

Company .....

Address .....

Don't take chances

Use the glass that is sometimes specified by users as the unbreakable gauge glass.

use SONDERGLASS

Widen the margin of safety and make sure that every gauge glass used in the boiler room is Sonderglass.

The double, semi-metallic construction, makes Sonderglass impervious to heat and cold. Sudden blasts have no effect on it. High pressures do not affect it.

It is always clear, eliminating inaccurate readings.

And Sonderglass *is safer*. Just make a test yourself.

and Reflecting Type for dark places

—a red stripe on a white background, magnified by the water, which gives a no-guess indication at a distance or in the shadows. Otherwise, the same as the regular style.

A. W. Chesterton Company
64 India Street, Boston, Mass.

Geo. B. Carpenter Co., 440 N. Wells St., Chicago
Somers Fitler & Todd Co., 313 Water St., Pittsburgh
Warren & Bailey Co., 214 E. Third St., Los Angeles
John Simmons Co., 102 Center St., New York
The Dixie Packing Co., Atlanta, Ga.
The General Rubber & Supply Co., Portland, Oregon

Lytle Engineering Co., Limited
842 St. James St., Montreal, P. Q.

BOILER

Large stocks of standard boiler tubes carried in our warehouses assure prompt deliveries throughout the United States. Every attention given special orders.

Write for further details.

THE TYLER TUBE & PIPE CO.
WASHINGTON, PA.

WAREHOUSE STOCKS: Boiler Tube Co. of America, Pittsburgh and Brooklyn; John McKenzie & Co., Inc., Baltimore; Tidewater Supply Co., Inc., Norfolk, Va., Columbia, S. C.; Joseph T. Ryerson & Son, Inc., Cincinnati, Cleveland; A. M. Castle & Co., Chicago, Seattle, San Francisco, Los Angeles; Lukens Steel Co., New Orleans; Harrisburg Pipe & Pipe Bending Co., of Texas, Inc., Houston, Texas; Harrisburg Supply Co., Tulsa, Oklahoma.

Special Representatives: W. M. MacCleary, 2 Rector St., New York; W. H. S. Bateman & Co., Philadelphia.

New England Representative: George W. Denyven, 250 Stuart St., Boston.

TUBES

COMPLETE STOCKS

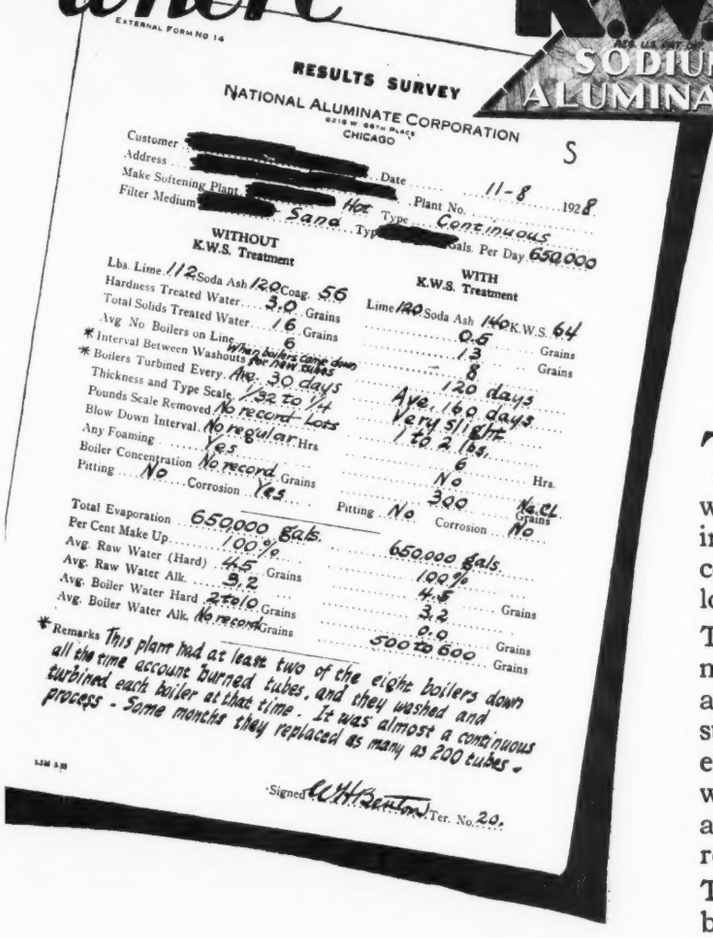
STRAIGHT tubes for fire tube and water tube boilers. Bent tubes for multiple drum boilers. Tubes of any gauge to fit any type of boiler. Special tubes bent to order. Water back tubes, superheater tubes... All our tubes are the product of nationally known manufacturers. Fast service.

BOILER TUBE COMPANY OF AMERICA

"World's Fastest Boiler Tube Service"

CHICAGO Main Office and Works: NEW YORK
3124 Preble Avenue, PITTSBURGH, PA.

Another case where K.W.S. SODIUM ALUMINATE helps hot-process softener



EXTERNAL FORM NO 14

RESULTS SURVEY

NATIONAL ALUMINATE CORPORATION
6216 W. 66th PLACE
CHICAGO

Customer [redacted] S
Address [redacted] Date 11-8 1928
Make Softening Plant [redacted] Hot Type Continuous
Filter Medium [redacted] Sand Type [redacted] Gals. Per Day 650,000

	WITHOUT K.W.S. Treatment	WITH K.W.S. Treatment
Lbs. Lime	112	120
Soda Ash	120	140
Coag.	56	K.W.S. 64
Hardness Treated Water	3.0 Grains	0.5 Grains
Total Solids Treated Water	16 Grains	13 Grains
Avg. No. Boilers on Line	6 When boilers come down for new tubes	8
* Interval Between Washouts	Avg. 30 days	120 days
* Boilers Turbined Every		Ave. 160 days
Thickness and Type Scale	1/32 to 1/4	Very slight
Pounds Scale Removed	No record Lots	1 to 2 lbs.
Blow Down Interval	No regular Hrs	6 Hrs.
Any Foaming	Yes	No
Boiler Concentration	No record Grains	300 Na.Cl Grains
Pitting	No Corrosion Yes	Pitting No Corrosion No
Total Evaporation	650,000 Gals.	650,000 Gals.
Per Cent Make Up	100%	100%
Avg. Raw Water (Hard)	4.5 Grains	4.5 Grains
Avg. Raw Water Alk.	3.2	3.2
Avg. Boiler Water Hard	2 to 10 Grains	0.0 Grains
Avg. Boiler Water Alk.	No record Grains	500 to 600 Grains

* Remarks: This plant had at least two of the eight boilers down all the time account burned tubes, and they washed and turbined each boiler at that time. It was almost a continuous process - Some months they replaced as many as 200 tubes.

Signed [redacted] Ter. No. 20.

THE survey here reproduced represents conditions in many plants, where the operator is forced to undertreat in order to prevent foaming and as a consequence has to accept scale and tube loss as a lesser of two evils.

The use of K.W.S. Sodium Aluminate permitted a necessary increase in both lime and soda ash, without foaming, and resulted in (1) elimination of scale, (2) elimination of tube losses, (3) reduced wash out periods, (4) reduced turbining and (5) enabled them to establish a regular blowdown.

The plant had at least two of the eight boilers down all the time on account of burned tubes. Some months as many as 200 tubes were replaced. K.W.S. treatment now allows all 8 boilers to be kept in service continuously.

One of the chief advantages of using sodium aluminate in a hot process softener, is its action in removing soluble and finely divided silica which is not affected by lime or soda ash.

Treat your water right and it will treat you right

This advertisement is one of a series showing results achieved by K.W.S. Sodium Aluminate and the K.W.S. system of water treatment used in both external and internal treating for steam plants, and distilled or raw water ice plants. We will be glad to send you copies of recent results surveys made, or any literature covering particular conditions in which you are interested. The coupon is for your convenience.

NATIONAL ALUMINATE CORPORATION
CHICAGO
6222 West 66th Place

Specialists in water softening, filtration, process work, waste water disposal, and all problems involving water supply and treatment. Manufacturers of National dry chemical feeders.

Representatives in Principal Cities

National Aluminate Corporation
6222 W. 66th Place, Chicago, Illinois

☐ You may survey our water condition

☐ You may send an engineer to explain K.W.S. service

You may send literature on:

☐ External treatment of boiler water

☐ Internal treatment of boiler water

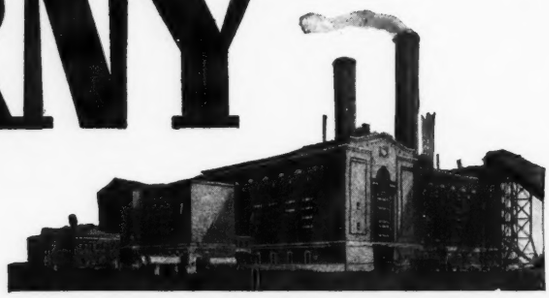
Name.....

Address.....

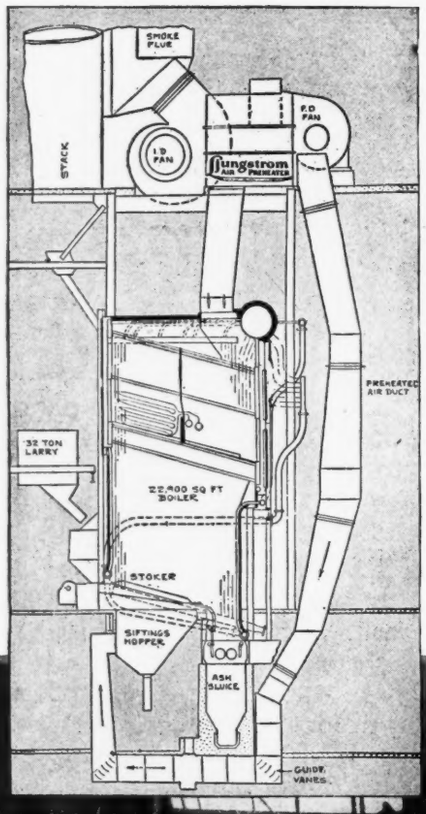
Company.....

P6-25-Gray

at KEARNY



Kearny Station of Public Service Electric and Gas Co.



KEARNY STATION is the pride of her owners—one of the biggest of the big, up to the minute in efficient mechanical equipment, produces at costs that can't be beat under similar operating conditions, and serves one of the most important districts in the United States.

In equipping the latest addition to this excellent plant, her designers well knew the typical benefits of waste heat recovery and preheating of combustion air, but were satisfied with nothing short of maximum benefits together with highest net annual money return on the preheater investment. The preheaters were therefore chosen only after these able Engineers were thoroughly convinced that the estimated economies and capacity increase would be met with a good margin.

The decision in favor of the six Ljungström Air Preheaters just recently put into service was based upon reasonable instal-

Typical installation at Kearny

ıation and operating costs and the year-in year-out dependability in other plants, together with the fact that the Ljungström Continuous Regenerative Counterflow Principle is the only one which makes as high heat recovery as 70 per cent commercially practical.

Two of these installations are shown in the photograph and the fan and duct arrangement are indicated in the diagram. Each pair of the six units serves a water-tube boiler of 22,900 sq. ft. of heating surface, and operating at ratings up to 400 per cent. Under normal operation at about 300 per cent of rating, the stack temperatures are reduced by the preheaters from 610 deg. Fahr. to 290 deg., the combustion air temperature is raised from 80 deg. to 425 deg., the boiler efficiency from 75½ per cent to 84½ per cent and a fuel saving of 10.5 per cent is effected.

Recent improvement in Ljungström Heating Surface for much faster heat extraction and delivery, and the corresponding reduction permitted in apparatus size, weight and cost for given capacity, enable the new models of Ljungström Preheaters to pay the highest net money return ever offered by waste heat recovery and utilization.

If your existing boiler equipment will not deliver fast enough to meet the peak loads, if you want the necessary extra capacity without the greater expense of adding more boilers, if you want to force your present boilers at higher rates without serious economy sacrifice, if you want a 10 to 15 per cent fuel saving at *all* loads or if you contemplate a new plant that will enable you to meet any competition, Ljungström Service Engineers make no charge for pointing out interesting possibilities, and offering helpful design suggestions.

The performance of Ljungström Air Preheaters is guaranteed in every respect and we will gladly refer you to numerous installations where the savings, etc., are highly gratifying to the owners.

AT LEAST ASK US FOR OUR NEW CATALOG.

The Ljungström is the only universally used Air Preheater—Over 750,000 hp. in service in the U. S. A.

THE AIR PREHEATER CORPORATION
40 E. 34th St., New York

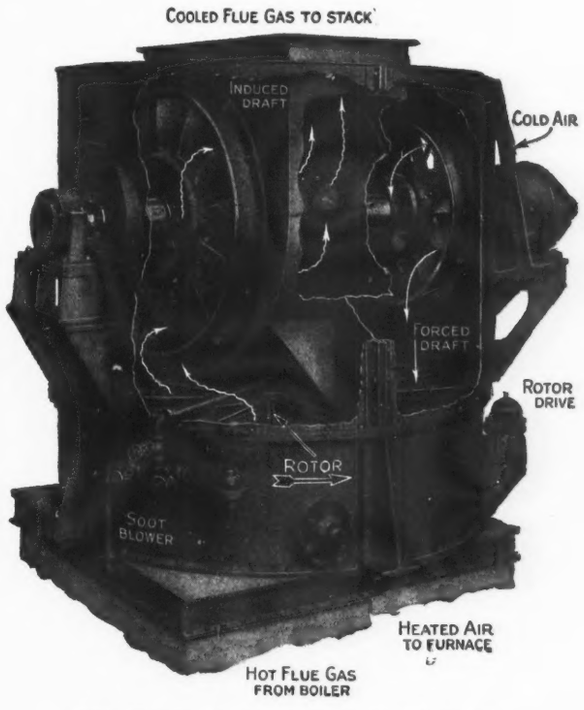
Works: Wellsville, New York. Agents in

Boston	Charlotte	Cleveland	St. Louis	Pittsburgh	Houston
Buffalo	Denver	Philadelphia	New Orleans	Cincinnati	Los Angeles
Chicago	Detroit	Minneapolis	San Francisco	Kansas City	Tacoma

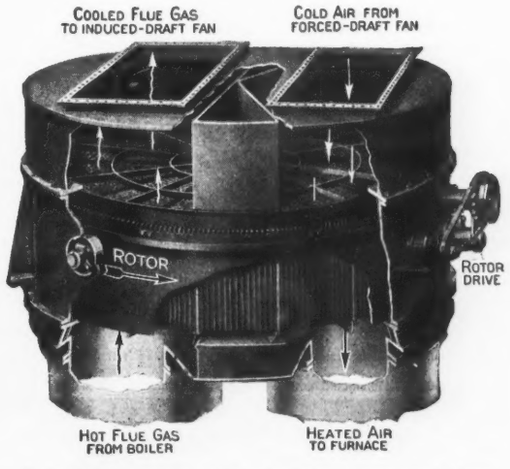
Canada, **Lammers & Maase, Ltd.**, Montreal and Vancouver

How the Ljungström Air Preheater operates

FLUE gas is drawn upward in one vertical half of the casing and combustion air is forced downward through the other. Opposite sides of a rotor containing a honeycombed mass of metal heating surfaces with vertical passages are simultaneously interposed in the two streams. In that part of the rotor which is in the gas path, heat is absorbed and stored in the metal mass. Slow rotor movement continually carries this heated metal into and through the air passage, where the heat is discharged into the combustion air. Similarly, the cooled metal is constantly being carried back into the flue gas to be reheated. The process is continuous at a rotor speed not exceeding 4 r.p.m., and each revolution completes a heat transfer cycle. Integral forced-draft and induced-draft fans or independent fans of any standard make may be used.



With integral forced-draft and induced-draft fans.

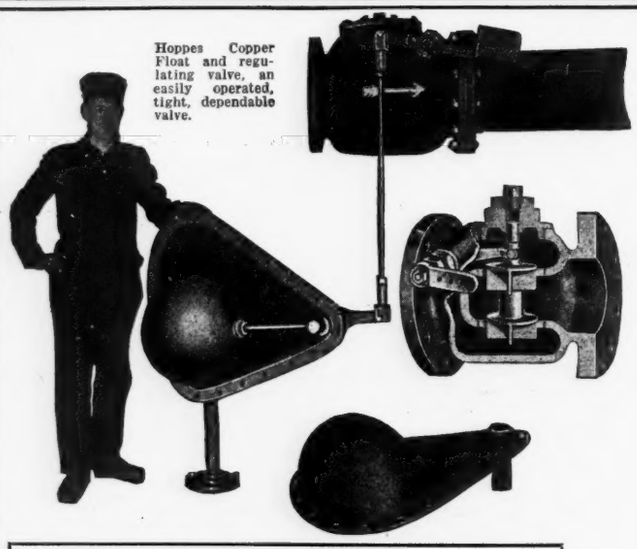


Type CANX for use with independent forced-draft fans.

Ljungström AIR PREHEATER

REG. U.S. PAT. OFF.

CONTINUOUS REGENERATIVE COUNTERFLOW



Hoppes Copper Float and regulating valve, an easily operated, tight, dependable valve.

FOR DRY AND CLEAN STEAM—ALWAYS

Vertical and Horizontal Hoppes Steam Separators

The Hoppes Oil Eliminator

For the better control of water and other liquid levels . . . .

The high buoyancy and long life of

HOPPES

COPPER FLOATS

make them highly desirable for every important float control.

The floats are spun from a heavy gage copper and are strongly reinforced with inside bands of copper. They are supported on a rod, which passes through a copper tube that extends across the full float diameter. The seams are solder sweated, and the entire outside surface is heavily plated with copper.

Write for catalog, covering the HOPPES line of feed water heaters and purifiers, deaerating and non-deaerating types; meters; exhaust heads; steam separators; oil eliminators; barometric surface condensers; copper floats; and other equipment.

The Hoppes Manufacturing Company
19 Larch St., Springfield, Ohio

GREEN'S

ECONOMIZERS
AIR PREHEATERS
FORCED DRAFT FANS
INDUCED DRAFT FANS
CINDERTRAPS. DUSTRAPS

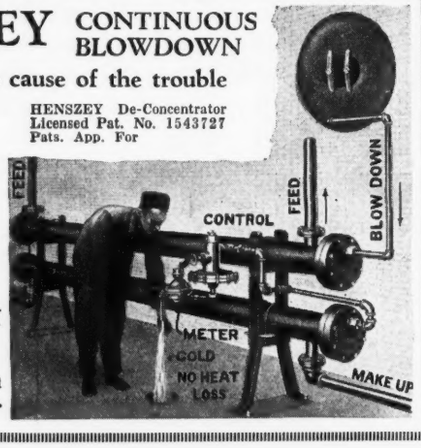
THE GREEN FUEL ECONOMIZER CO.
BEACON, N. Y.

HENSZEY CONTINUOUS BLOWDOWN

Removes the cause of the trouble

No Scale
No Priming
No Heat Loss

HENSZEY De-Concentrator Licensed Pat. No. 1543727 Pats. App. For



HENSZEY De-Concentrator Company
Watertown, Wis.

D. H. SKEEN & CO.
General Sales Agent
53 W. Jackson Blvd.
Chicago

Soft Water

For all industrial purposes
Send for circular P

PARAMOUNT WATER SOFTENER CORP.
90 West Street, New York

THERMIX AIR HEATER and THERMIX STACK

THERMIX AIR HEATER. Plate type; for recovery of heat in flue gas. *Write for Catalog 10-T.* THERMIX STACK. Fan and Stack built as a unit. *Write for Catalog No. 10-S.* THERMIX CINDER REMOVING STACK. Fan and cinder remover combined as a unit, with or without stack. *Write for Catalog No. 10-C.*

Prat-Daniel Corporation, 183 Madison Ave., New York, N. Y.

Water Purification

Softeners and Filters

for every industrial and domestic use

Wm. B. Scaife & Sons Co., Oakmont, Pa.
PITTSBURGH NEW YORK CHICAGO

"MAGIC" Boiler Preservative

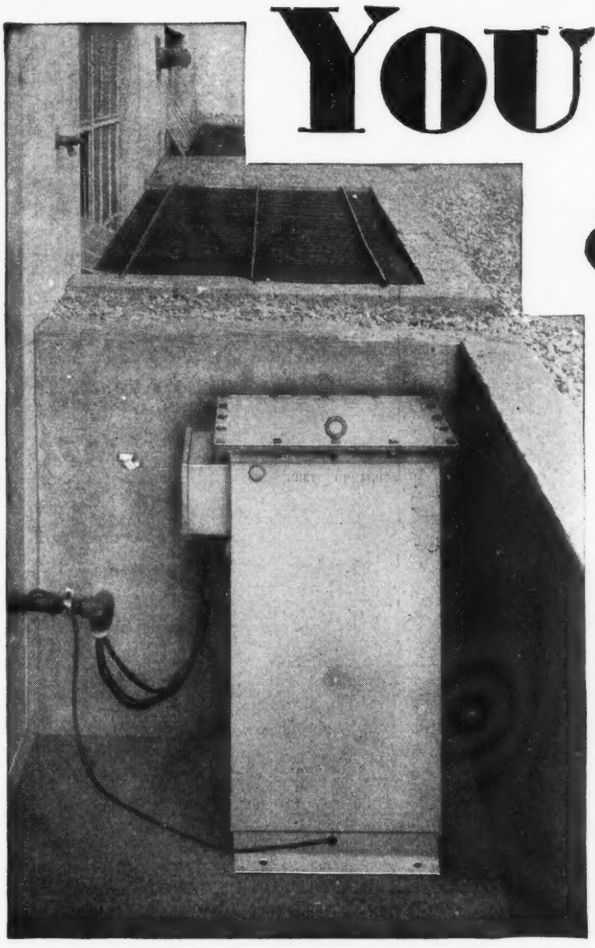
Twenty-Five Years' Experience!

Positive proof that "Magic" WILL do the work, i.e., prevents and stops scale formation, minor leaks, pitting and corrosion.

MAGIC
THE FILM FOR BOILERS

GARRATT-CALLAHAN CO.
New York CHICAGO San Francisco

YOU CANNOT afford to ignore POWER FACTOR

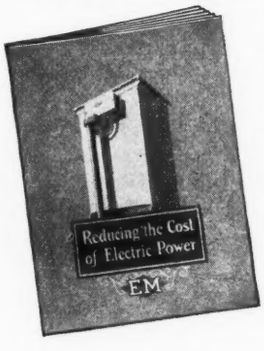


That it pays even small users of electric power to improve power factor is well shown by this installation at the Schaibles Bakery Co., Easton, Pa. This 20 kv-a., 220-volt E-M Capacitor saves $300 annually which, in 2 years, will have absorbed the cost of the Capacitor

EVERY plant using alternating current must consider power factor. Power factor is a measure by which is indicated how much of the power consumed is "working" power and how much is magnetizing power. Whether you buy power or generate it yourself, this element of magnetizing power may cut into profits if ignored.

When power factor is low, larger generators are required, larger transformers and larger distribution wires—line voltage is low, impairing the performance of motors and machines—these unnecessary costs, in every case, being a slice out of the possible profits of the power user. Improve your power factor and you improve the ratio of profits to money invested.

Get this 48-page book on Capacitors



Executives may learn more about power factor, its detrimental effects, and remedies for low power factor, by writing for this 48-page book—"Reducing the Cost of Electric Power". Sent free on request.

Electric Machinery Mfg. Co.

Specialists in Apparatus for Power Factor Improvement

1345 Tyler Street, N. E. Minneapolis, Minn.

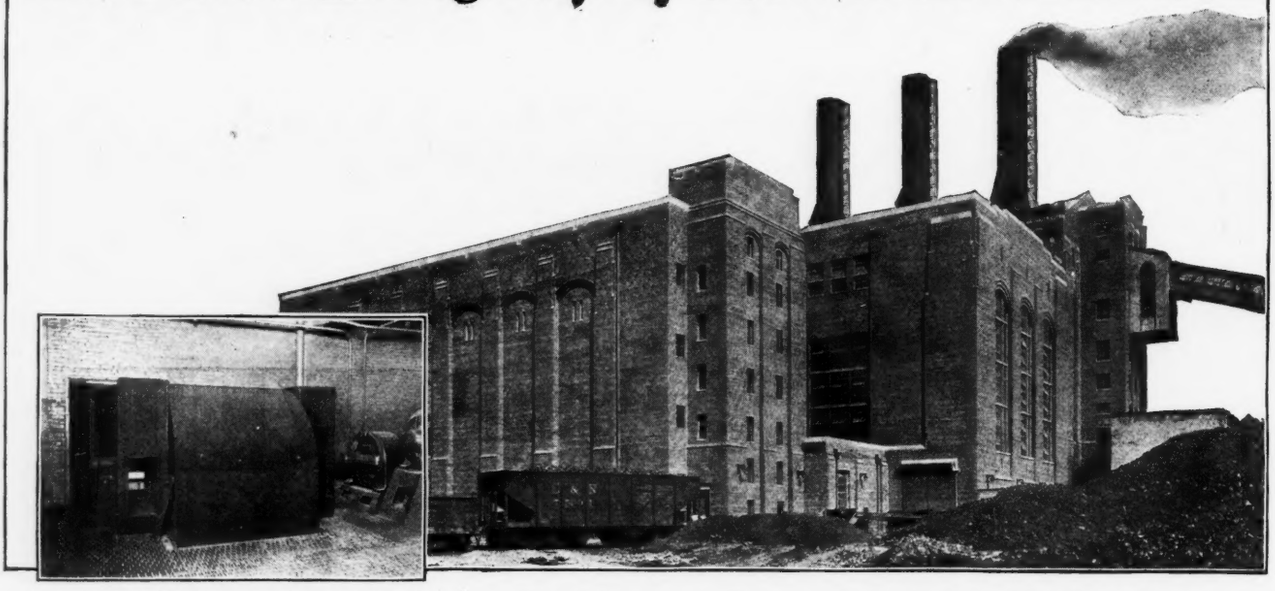
Sales Offices in Principal Cities

EM *Power Factor Improvement* CAPACITORS

STATIC CONDENSERS THAT MATERIALLY CUT POWER COSTS

(4375

An Outstanding Bayley Blower Installation



One of six Bayley Aerovane Blowers installed at Morrell St. Station, Detroit Lighting Commission.

Bayley
AIR ENGINEERING & EQUIPMENT
HEATING AND VENTILATING
AIR WASHING AND HUMIDIFYING SYSTEMS
MILL EXHAUSTERS—PRESSURE BLOWERS
MECHANICAL DRAFT FANS
AIR AND GAS SCRUBBERS
INDUSTRIAL DRYING SYSTEMS

The Morrell St. Station of the Detroit Lighting Commission, Detroit, Michigan, in which there are installed six Bayley Aerovane Blowers for secondary forced draft, six steel plate Bayley Blowers for primary forced draft and six Bayley Plexiform Fans for induced draft. Write for catalog No. 32 describing this installation in detail.

BAYLEY BLOWER COMPANY
774 Greenbush St., Milwaukee, Wis.

Coppus Manhole Blower

For cooling and ventilating boilers, tanks, etc.—easily hooked up to manhole.

Heat Killer

A universal man-cooling fan of unequaled efficiency.

118 lbs.

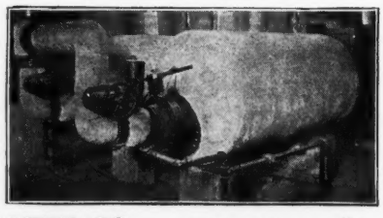
Coppus Engineering Corp.
350 Park Ave., Worcester, Mass.

For Hot Water—

Whether your need is for feed water, a heating system or a manufacturing process or a domestic purpose—the cost will be less if you heat the water in

ALBERGER-BUFFALO Heaters

Scientifically designed for high heat transfer, with Helically corrugated copper tubes. Divided floating tube head that eliminates expansion stress. Consult us on your requirements. Write.



ALBERGER HEATER CO., HOWARD IRON WORKS
283 Chicago St., Buffalo, N. Y.

FOR EVERY BOILER—STOKERED OR HAND FIRED

WING BLOWERS

7TH AVE. & 14TH ST. NEW YORK

NEEMES

GRATES AND STOKERS

Shaking and Dumping Grates — Fully Automatic Stokers
Send for bulletins
Neemes Foundry, Inc., Troy, N. Y.

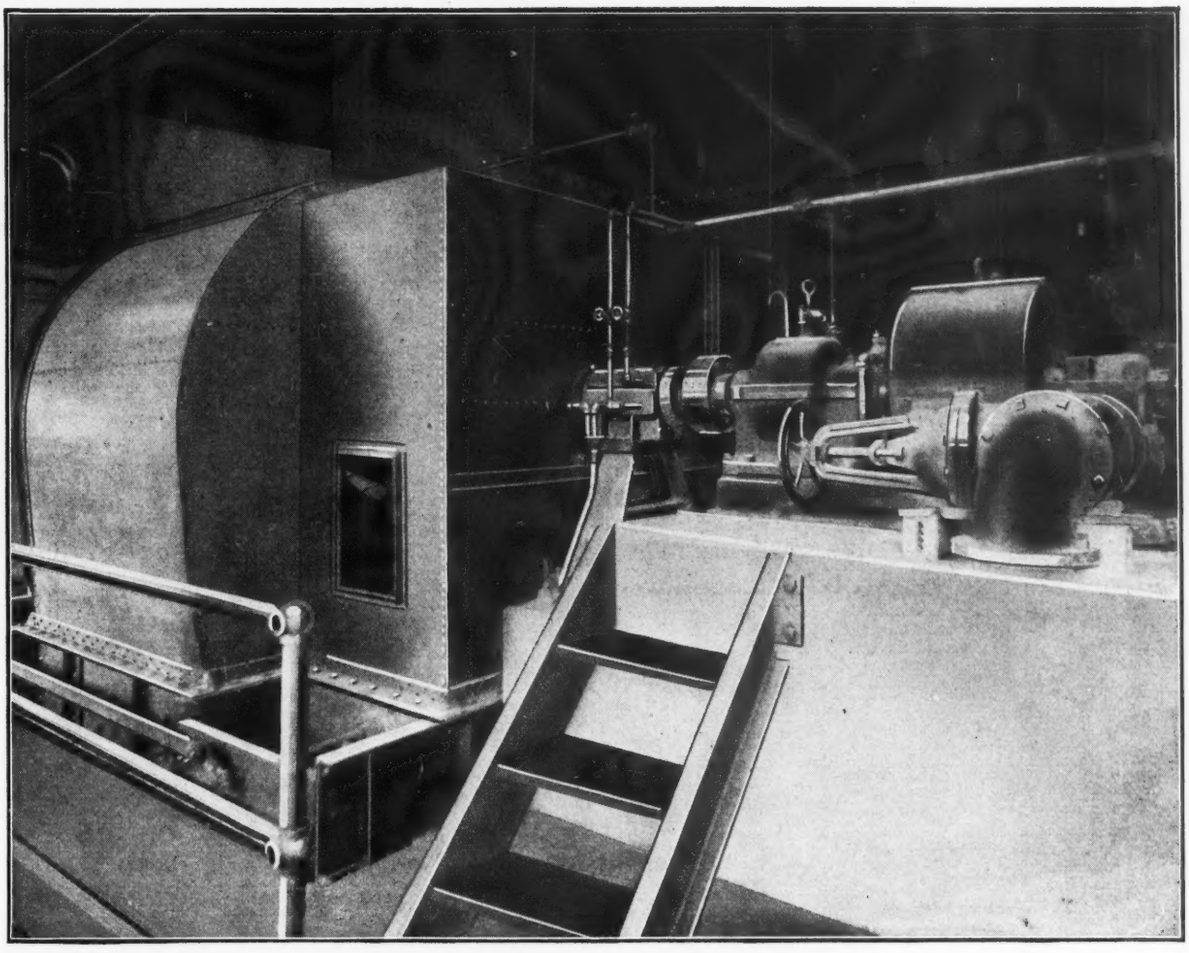
LACLEDE CHAIN GRATE STOKER

The stoker for the higher volatile coals, dominant in this field today.

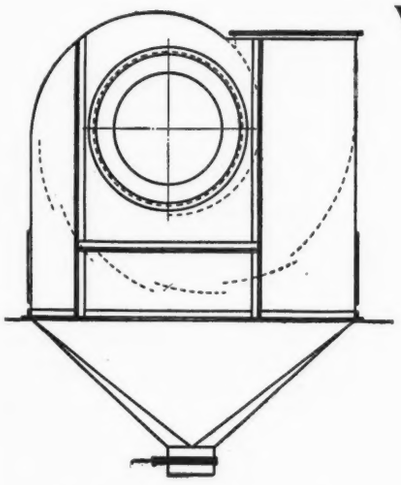
Full Details Will Be Sent on Request
LACLEDE STOKER CO., 4438 Hunt Ave., St. Louis, Mo.

CYCLONE GRATES

Make *all* of your fuel count in power.
Write for Full Details.
CYCLONE GRATE BAR CO.
9 Grimes St., Buffalo, New York



AN INDUCED DRAFT FAN
which efficiently separates solids from air and gases



Cinders and Dirt Are Caught in a Hopper

BUFFALO Cinder Eliminating Induced Draft Fans not only induce draft at high efficiency but also clean the stack gases of cinders and dust. The dust and dirt removal is accomplished by slots in the stationary scroll of the housing, a simple but effective design. Since the rotor does not use slotted or special blades, it cannot become clogged and consequently unbalanced.

For complete particulars write for our circular No. 2669.

Buffalo Forge Company

488 Broadway, Buffalo, N. Y.

In Canada: **Canadian Blower & Forge Co., Ltd., Kitchener, Ont.**

"Buffalo"

Mechanical Draft Apparatus for Continuous Dependable Service

More steam from less fuel

The better combustion afforded by the Kelly Improved Hand Stoker not only enables you to get more out of your steam plant, but brings a gratifying reduction in fuel consumed.

The Kelly Hand Stoker Grate with bars raised and dump plate dropped in full dumping position.

Further, the Kelly makes the cheapest fuels available and burns them with a good, clean flame. No wonder, then, that Kelly owners realize a saving from 10 to 25% in their fuel bills.

Write for Details.

KELLY

Easy to install
Easy to operate
Backed by complete Kelly Service

THE KELLY FOUNDRY & MACHINE CO.
614 NINTH ST. Est. 1887 GOSHEN, INDIANA

Chicago Office 178 W. Adams St.
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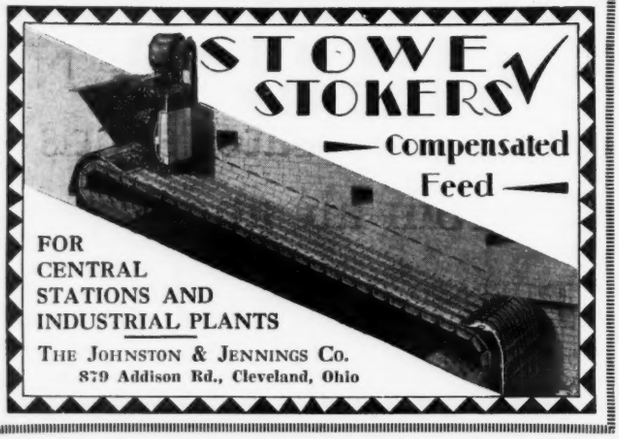
STOWE STOKERS ✓
Compensated Feed



FOR CENTRAL STATIONS AND INDUSTRIAL PLANTS

THE JOHNSTON & JENNINGS CO.
879 Addison Rd., Cleveland, Ohio

THERE IS A
UNIPULVO
UNIT PULVERIZER
FOR EVERY BOILER
From One Hundred to One Thousand Horsepower
THE STRONG-SCOTT MFG. CO.
MINNEAPOLIS, MINNESOTA
Agencies in Principal Cities

MULTIPLE RETORT
TRIPLE RETORT
DOUBLE RETORT
SINGLE RETORT
UNISTOKER
INDUSTRIAL STOKERS

DETROIT-STOKERS

ASK FOR BULLETIN 999

DETROIT STOKER COMPANY
3RD FLOOR GENERAL MOTORS BUILDING
DETROIT
IN CANADA-DETROIT STOKER COMPANY OF CANADA LTD. WINDSOR

With Dampered Air Control

ILLINOIS
CHAIN-GRATE
STOKERS
ILLINOIS STOKER COMPANY
104 West 7th Street, Alton, Illinois
Representatives in Principal Cities of U. S. A. and at 900 Bay St., Toronto, Canada

Forced or Natural Draft

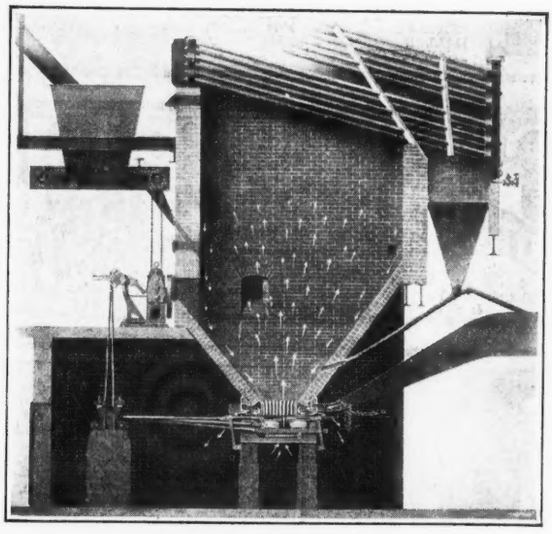
HUBER STOKER
PATENTED
A Stoker for Every Boiler

Write for interesting records of performance in representative plants, and a copy of "Five Minutes With the Coal Bill".

Flynn and Emrich Company
305 N. Holliday Street
Baltimore, Md.

STRATTON Vertical Jet FURNACE

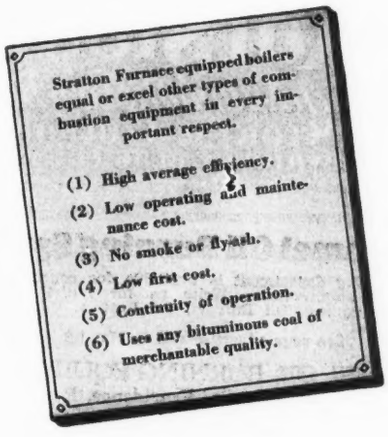
Fully Justifies Modernization
By Sufficiently Reducing Cost of Steam
And Total Power Plant Investment!



. . . AND WITH
ACCOMPANYING INCREASE
IN BOILER EFFICIENCY

STRATTON Vertical Jet FURNACE

burns *CRUSHED* coal in suspension
without fly-ash


Stratton Furnace equipped boilers equal or excel other types of combustion equipment in every important respect.
(1) High average efficiency.
(2) Low operating and maintenance cost.
(3) No smoke or fly-ash.
(4) Low first cost.
(5) Continuity of operation.
(6) Uses any bituminous coal of merchantable quality.

Charts of prominent industrial power plants afford ample testimony to the unusual degree of efficiency and economy that result from utilizing the vertical jet principle of combustion. Stratton Furnaces operating continuously without economizers and without air preheaters, have developed an average well over 200% of boiler rating, heat balance showing more than 78% heat absorption by boiler.

Such increase in furnace capacity with accompanying reduction in operating and maintenance costs cannot fail to materially lower the total investment in steam plant equipment, and the cost of steam.

Stratton Furnaces can be installed at a cost which will be completely justified by the resulting economy.

Eliminates Pulverizing (with attending expenses)

It is only necessary to CRUSH coal to pass a ¼-in screen for Stratton Furnaces. Bituminous coal of any merchantable quality can be used. Our engineering department will gladly prepare a preliminary analysis of your particular situation, without cost to you.

STRATTON ENGINEERING CORPORATION

116 East 18th Street, New York City

Canadian Representative—ROSS ENGINEERING OF CANADA, LIMITED, MONTREAL

Copy on request

At Long Beach

they use

HYTEMPITE

and the

QUIGLEY

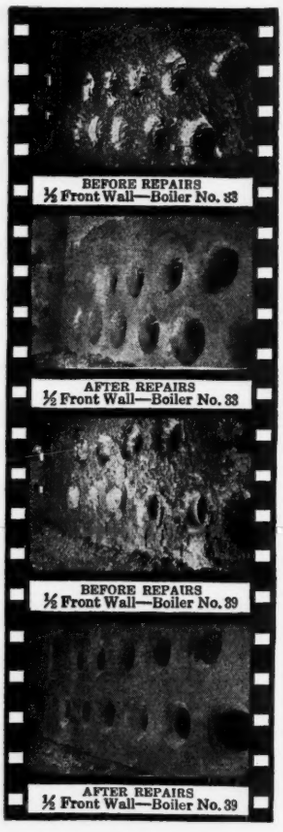
Refractory Gun

on boilers operated at

280% Rating

They say:—

"We are using the Quigley Refractory Gun and wash regularly with HYTEMPITE every time a boiler comes out of service. Our furnaces are still in good condition after nearly four years of operating around 280% rating. We think HYTEMPITE has been of considerable value in maintaining this rather excellent record."



HYTEMPITE — The standard for comparison in High Temperature Cements, is used throughout the world for

REFRACTORY CONSTRUCTION And MAINTENANCE

Shipped Sealed in Steel—Ready for use.

Stock and Service Men in Every Industrial Center.

QUIGLEY FURNACE SPECIALTIES CO., INC.
56 West 45th Street New York

CUSTODIS CHIMNEYS

Alphons Custodis Chimney Construction Co.
95 Nassau Street, New York Marquette Bldg., Chicago

Perforated Radial Brick Chimneys

Reinforced Concrete Chimneys

Builders of the Tallest and Largest Brick Chimneys in the World

Chimneys of all Sizes for all Purposes for Steam Boilers, Furnaces, Chemical Plants, Destructors, etc. Experts in repairing chimneys. Lightning Rods installed and repaired. Specifications, plans, designs and data furnished free upon request.

Send for free booklet P4 "How to Determine the Proper Size of Chimney" and "A Treatise on Calculation of Stresses in Brick Chimneys."

ATLANTA, BOSTON, CLEVELAND, DETROIT, DALLAS, MILWAUKEE, MINNEAPOLIS, PHILADELPHIA, PITTSBURGH, PORTLAND, ORE., RICHMOND, ST. LOUIS, SEATTLE, TORONTO, MONTREAL, VANCOUVER, HALIFAX

GENERAL REFRACTORIES COMPANY

106 South 16th St., Philadelphia, Pa.

Fire Clay, Silica, Chrome, Magnesite and Diaspore (High Alumina) Refractories, Grefco Chrome High Temperature Cement.

Branch Offices: Boston Buffalo Chicago Cleveland Detroit New York Pittsburgh San Francisco Seattle; F. T. Crowe, Montreal, Canada: Webster & Sons, Ltd. Havana, Cuba: Woodward & MacMillan

B&W No. 80 Refractories

Special materials for severe furnace conditions. Standard and Special Shapes, High Temperature Cements, and Plastic.

THE BABCOCK & WILCOX CO.
85 Liberty St., New York, N. Y.
Offices in principal cities.

FIRE BRICK

Quality Since 1857

EASTERN OFFICE
11 Park Place, New York

Plants at
ST. LOUIS, MISSOURI
STEVENS POTTERY, GA.
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EVENS & HOWARD FIRE BRICK CO.
Main Offices, 920 Market Street, St. Louis, Mo.

CoKal Stokers

are Modern Automatic Coal Burners

COKAL STOKER CORPORATION
1014 WRIGLEY BLDG., CHICAGO.

Hammel Oil Burning System

Our engineering department is available for consultation on your oil burning requirements. Write us for Bulletins covering our Oil Burning System, Oil Burners, Oil Heaters, Oil Pump Sets and Accessories

See page advertisement in May 28 issue.

HAMMEL OIL BURNING EQUIPMENT CO.
409 Pine St., Providence, R. I.

WOOLLEY OIL BURNERS

—Mechanical Atomization—

E. L. WOOLLEY & COMPANY
INDUSTRIAL TRUST BLDG. PROVIDENCE, R. I.

PEABODY

BURNERS *for* ALL FUELS

Peabody Engineering Corp'n, 112 E. 42nd St., New York, N. Y.

COEN

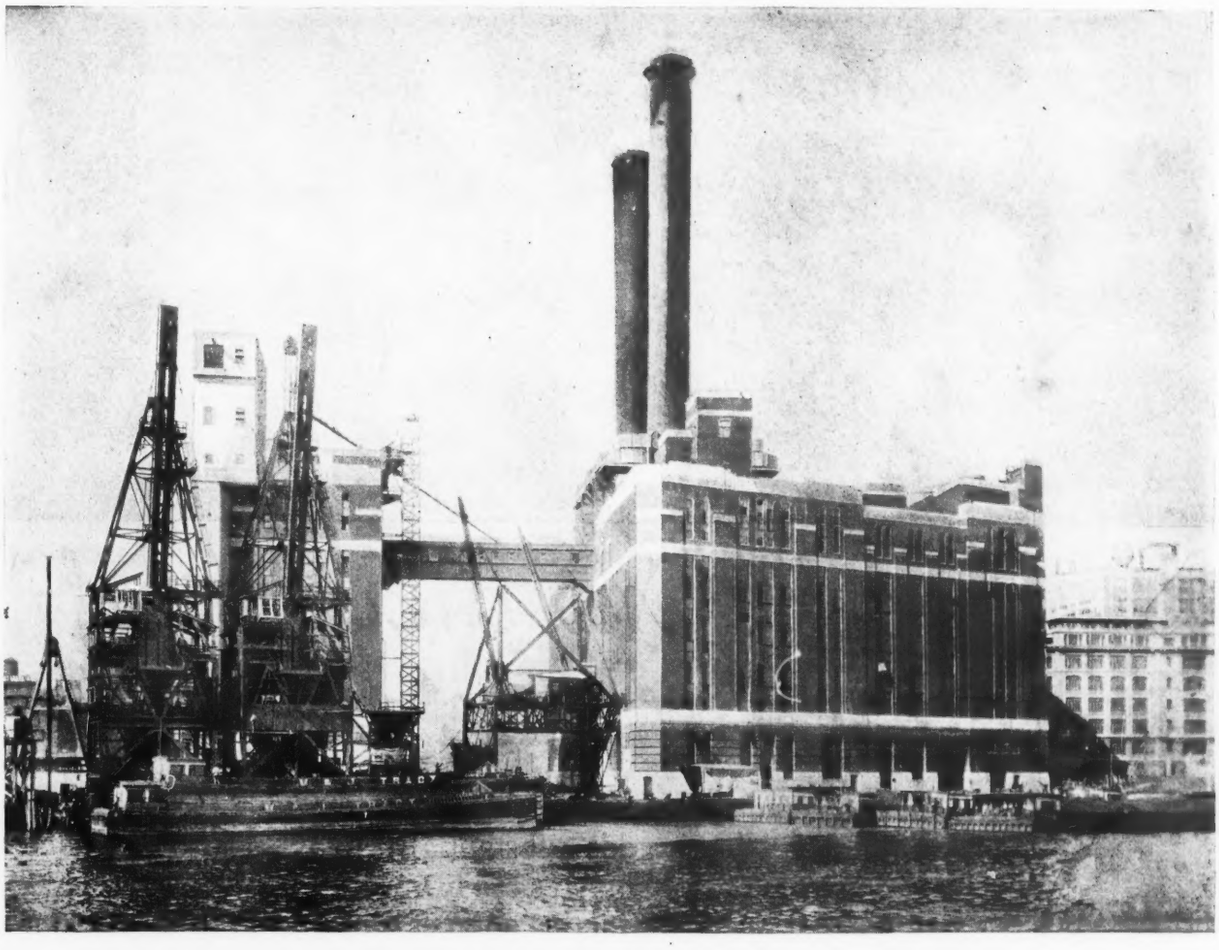
for Steam Economy

OIL, GAS, AND POWDERED FUEL BURNERS
IMPROVED AIR REGISTERS

Wide flexibility—Wide Range—Ideal Flame Control
Increased Output any type boiler—Write for Bulletin "M"

COEN COMPANY, INC., 50 Church St., New York
112 Market St., San Francisco Story Bldg., Los Angeles

SMOOT CONTROL



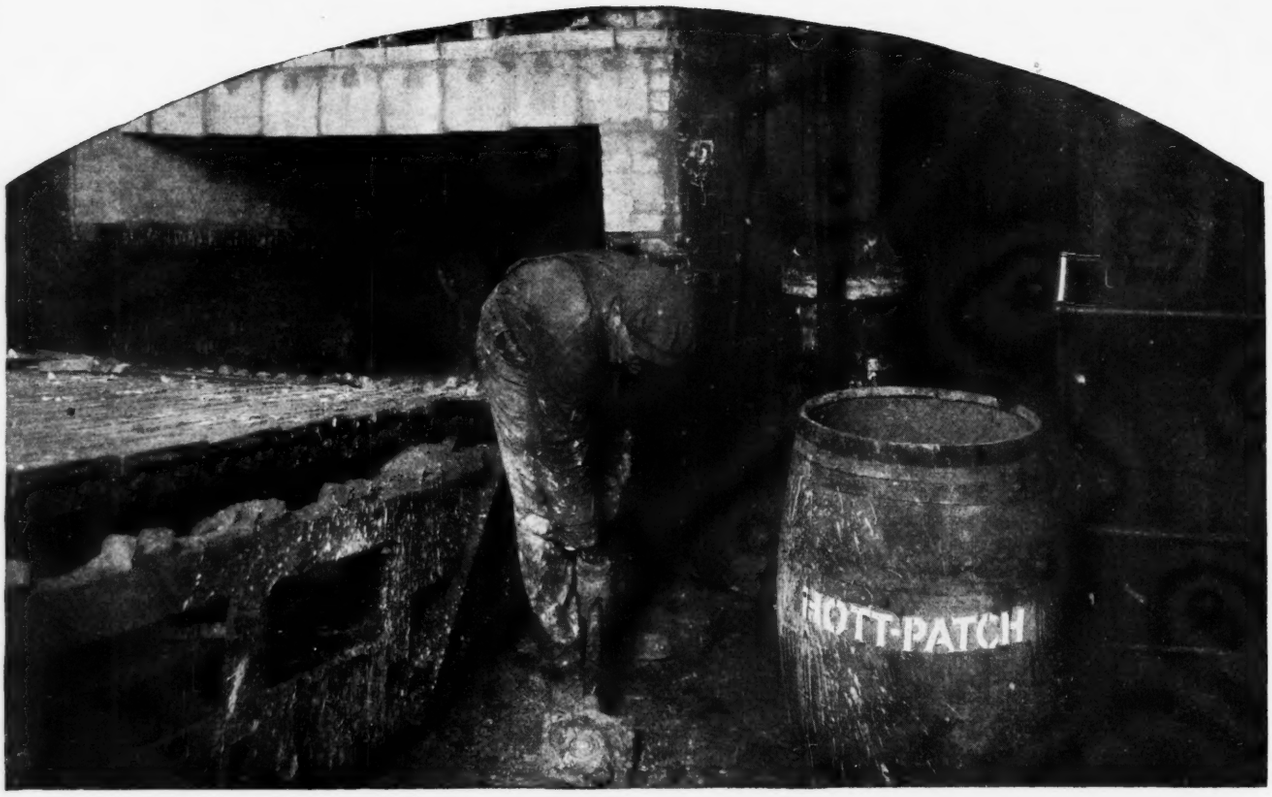
East River Station of the New York Edison Co.

The three new 800,000 lb. boilers in the East River Station will be operated with full **Smoot Control of Combustion.** This extension was justified by the operating experience, with the original unit of six boilers. **Smoot Control** at the East River Station includes the regulation of the following operating items:

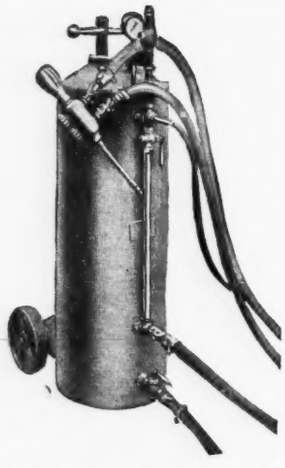
Steam Pressure
Feed Water Excess Pressure
Load Distribution, between Boilers for Constant or Variable Rating
Pump Pressure
Fuel Feeders
Induced Draft Fans
Forced Draft Fans
Primary Air Fans
Primary Air Pressure
Condenser Hot Well Level
Main Unit Steam Bleed

SMOOT ENGINEERING CORPORATION

136 Liberty Street **New York**



Cut the cost of refractory maintenance



Hott-Patch is most easily and economically applied with the Hott-Patch Gun, which is conveniently operated by one man. Requires but 60 lbs. air pressure, and sprays 20 gallons at one filling.

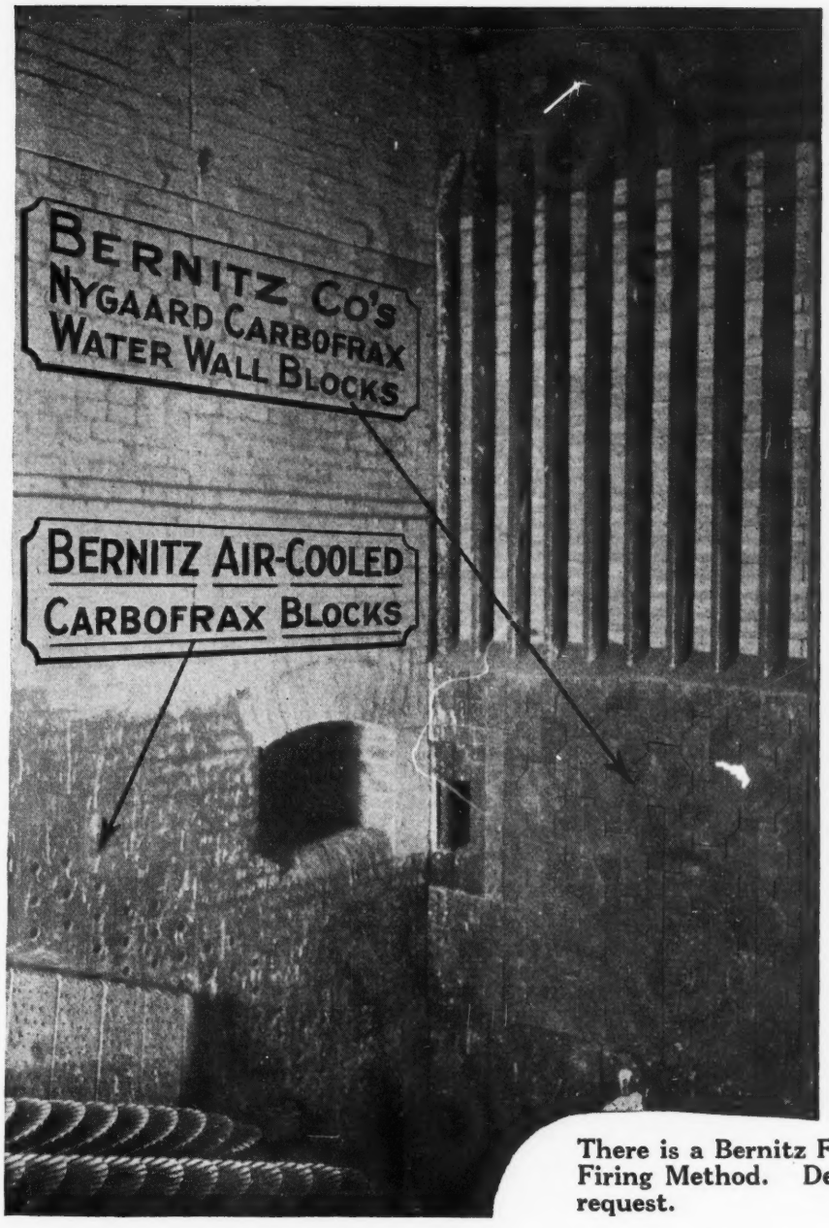
It is the regular experience of those who give Hott-Patch a trial that its use adds substantially to the life of furnace linings. Hott-Patch takes the brunt of the furious temperatures that modern practice entails, protecting the walls from deterioration. It clings firmly under all conditions, yet it contracts and expands freely with even the most sudden changes in temperature. It will not crack or spall, or put the bricks under strain. The secret lies in the structure of Hott-Patch. It is filled with microscopic pockets that take up all expansion and contraction. These pockets are developed by the burning out of its vegetable binder.

The practice of spraying Hott-Patch each time a furnace is shut down has been adopted in many plants with highly gratifying results.

Write for details.

***The* S. OBERMAYER CO., 2563 West 18th St., CHICAGO**

HOTT-PATCH



Reliable Furnace Operation over Wide Range of Ratings

There is a Bernitz Furnace Lining for Every Fuel and Firing Method. Descriptive bulletins will be sent on request.

You can depend on ***Bernitz Air-Cooled Carbofrax Furnace Walls*** to withstand the onslaught of high furnace temperatures, flame and slag erosion, and adhering clinkers that quickly destroy ordinary linings. Even under the severest furnace conditions the life of Bernitz Blocks is measured by Years, not Months. Setting maintenance and boiler outages are reduced to a minimum and at the same time highly efficient combustion results may be constantly obtained.

Likewise with water wall construction the Bernitz, Nygaard design, Carbofrax Block Covering can be relied upon not only to amply protect the water wall tubes but also to maintain active combustion in close proximity to wall over very wide range of ratings. When you install or remove Nygaard Water Wall Blocks the entire operation is made from the fire side, and because of their unique design the Blocks are always in positive contact with the tubes.

BERNITZ FURNACE APPLIANCE COMPANY

Water Wall Construction, Carbofrax, Fire Clay, and Cast Iron Facing Blocks for new or existing water wall installations.

Main Office:
89 Broad Street
Boston, Mass.

District Offices in Principal Cities

Bernitz Carbofrax and Fire Clay Air-Cooled Furnace Walls and Floors.
Perforated and Non-Air Admission Types.

Bernitz Carbofrax Blocks are made for us exclusively by the Carborundum Company

(Carborundum is the Registered Trade Mark of The Carborundum Company and is its exclusive property)

Again

The Illuminating Company Repeats—*'24, '25, '27, '28 and 1929*

The Cleveland Electric Illuminating Company's record of repeat orders for Detrick Air-Cooled Walls speaks for itself:

1924—Three installations at 20th Street Heating Plant
1925—Four at Avon Power Station
1927—Another at 20th Street
1928—Two more at Avon Station
1929—Still another two at Avon

The illustration shows a Detrick Wall and Arch after two years of service at the Avon plant—*without repairs.* Need we add any comment?

M. H. DETRICK COMPANY
140 South Dearborn Street, Chicago

New York...50 Church St.
Detroit.....Murphy Bldg.
Pittsburgh....Empire Bldg.
San Francisco...Russ Bldg.

DETRICK ARCHES & WALLS

"Better than the Refractory of which They are Made"

KROMEPATCH

REG. U.S. PAT. OFF.

CHROME ORE, which is noted for its chemically neutral characteristics, resistance to destructive elements, high fusion point and great hardness, is the base of all Chrome Refractories manufactured by E. J. Lavino and Company.

We picture above a representative lump of the highest grade refractory chrome ore obtainable which is used exclusively by this company to produce our dry chrome ore cement "KROMEPATCH."

Bond the brick in your boilers with this Multi-Bond Chrome Ore Cement.

Shipped dry in steel containers 200 lb. net weight.

Write for bulletins.

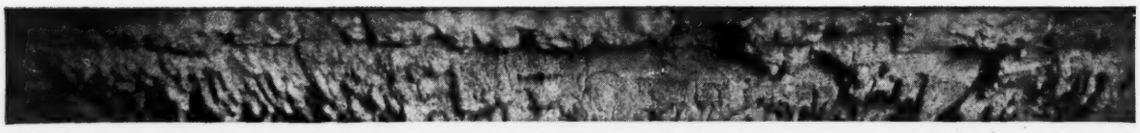
E. J. LAVINO AND COMPANY

"PIONEERS IN CHROME REFRACTORIES"

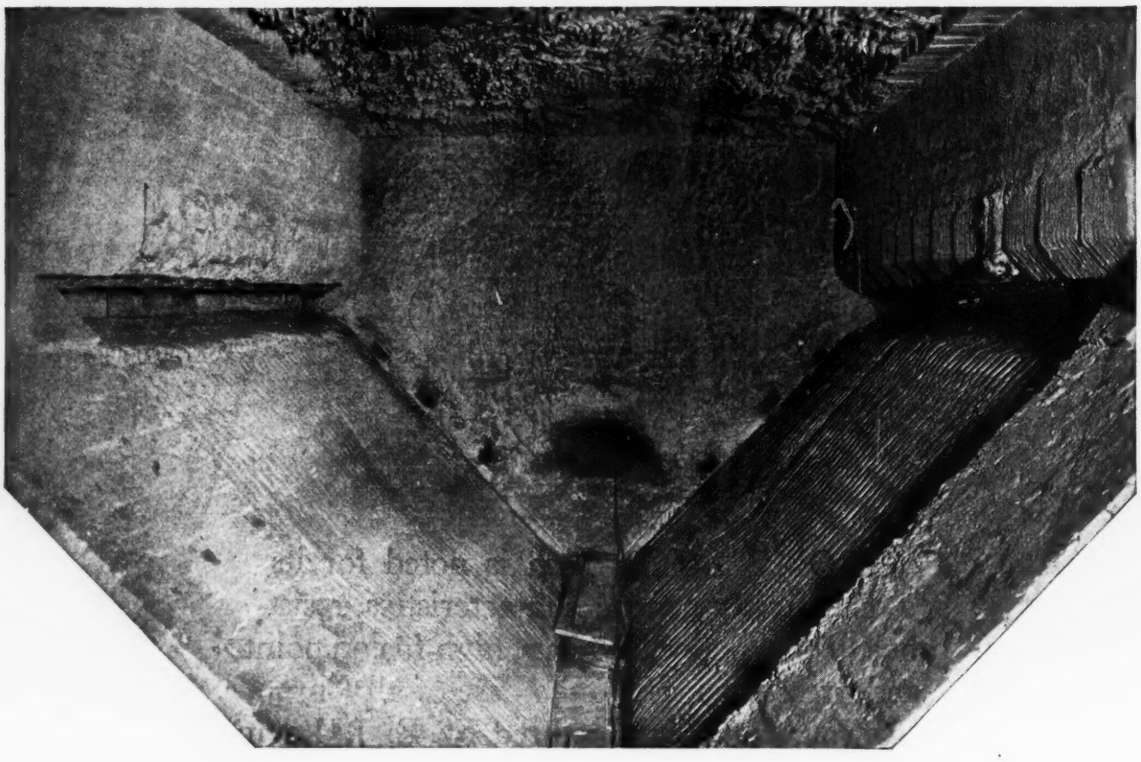
BULLITT BLDG.

PHILADELPHIA, PA.

PITTSBURGH, PA. CHICAGO, ILL.



SOLVE THAT PERPLEXING PROBLEM



—that Problem of Refractories with

Carbofrax
Reg. U. S. Pat. Off.
Brick

CARBOFRAX, the Carborundum Brand Silicon Carbide Brick will not soften at boiler furnace temperature—therefore there is no clinker fusion or adhesion.

¶The high mechanical strength of Carbofrax—its resistance to spalling and abrasion—its ability to stand up from two to five years even under severe conditions.

¶All of these characteristics should recommend Carbofrax as the solution of your boiler furnace refractory problems.

[Glad to have you consult with our Sales Engineers]

CARBORUNDUM BRAND REFRACTORIES
Reg. U. S. Pat. Off.

Carbofrax (Silicon Carbide) and Aloxite (Fused Alumina) Brick - Tile - Muffles - Cements

Carborundum is the registered trade mark of The Carborundum Company for its products.

THE CARBORUNDUM COMPANY, PERTH AMBOY, N. J.
REFRACTORY DIVISION

CHRISTY FIREBRICK CO., St. Louis, Mo. and New Orleans, La. PACIFIC ABRASIVE SUPPLY CO., San Francisco, Los Angeles and Seattle
HARRISON & CO., Salt Lake City, Utah WILLIAMS & WILSON, LTD., Montreal, Que. DENVER FIRECLAY CO., El Paso, Texas

STEEL MIXTURE boiler-door Arches in one of the boilers of the Security Mutual Life Insurance Building, Binghampton, N. Y. Asa P. Hyde, Chief Engineer, writes as follows:

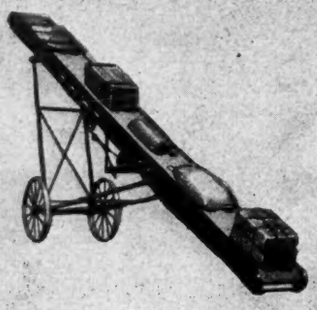
"Thinking it might interest you to know what the two sets of STEEL MIXTURE Arch Blocks purchased early in 1904 have been doing I am sending you a photograph. The boilers are of the h.r.t. type, 200 hp., grates 7′ wide by 7′ 6″ long. Boilers carry 115 lb. steam continuously, carrying a good outside load besides the load of the block, and run 24 hours the year round. At our peak load we often take off from 250 to over 275 hp. We have under another boiler a duplicate set of arch blocks, installed at the same time and operated alternately on runs from one to two months, and they are in the same condition. I hope this will prove as interesting to you as it has been profitable to us."

SUBSTANTIAL SAVINGS

If you have never used STEEL MIXTURE, naturally you will want some *proof* that it will effect substantial savings . . . In the first place, we can point to more than *sixteen thousand users.* Second, we can refer you to most of the biggest concerns in America as users of STEEL MIXTURE products. Third, we can quote any number of users who say that STEEL MIXTURE blocks last from two to six times as long as ordinary furnace linings. Finally, we call your attention to *more than a hundred years* of successful experience in this field . . . Write for latest Bulletins about STEEL MIXTURE boiler door arches, fire box blocks, air cooled walls, flat suspended arches, etc., CARBEX (silicon-carbide) super-refractories, and other well-known products. Please address McLEOD & HENRY CO., 31 Monroe St., Troy, N. Y.

STEEL MIXTURE
REG. U.S. PAT. OFF.

FURNACE REFRACTORIES



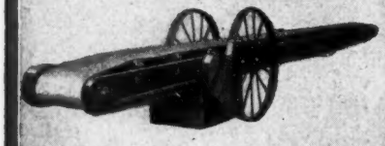
Freight Elevating

Sectional Trough

The Ace

Freight Horizontal

The Trough



The Type B

The Drag

Mine Car Loader

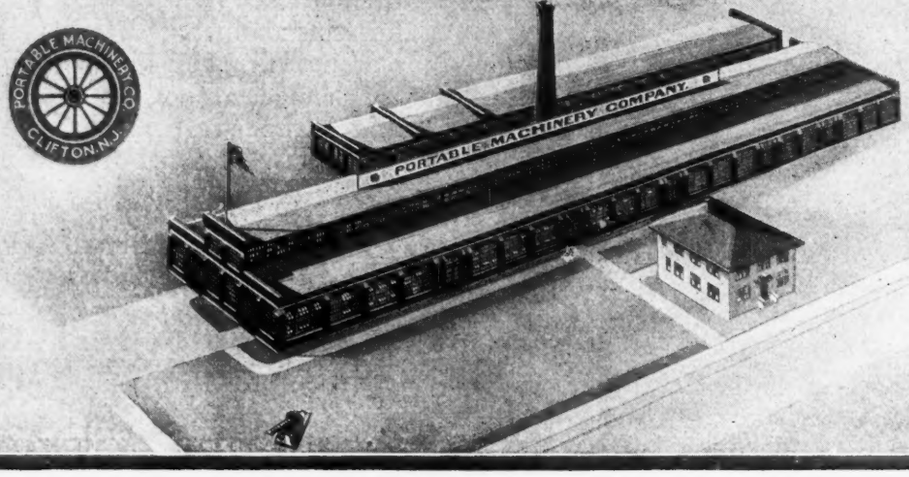
A SCOOP CONVEYOR will solve your handling problem

WE HAVE had many years of experience in solving handling problems for clients in practically every industry. There is a portable conveyor in our complete line best adapted to your particular plant lay-out and individual needs.

The Scoop Conveyor is constantly ready to deliver full service without standby losses. It conserves space in itself and in the storage of material. In addition to a complete line of standard Conveyors we manufacture Special Conveyors for handling all kinds of Loose and Bulk Materials.

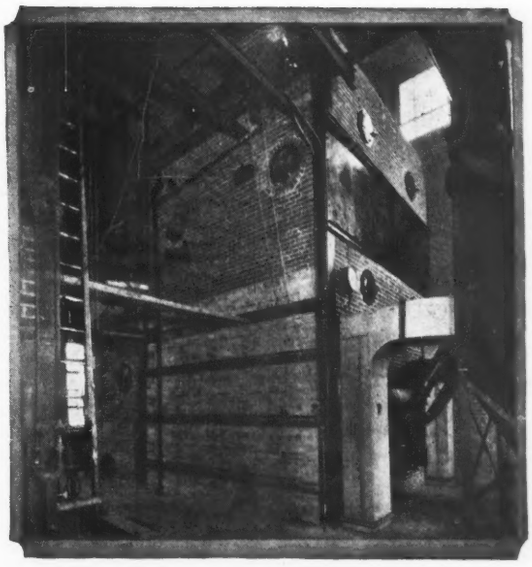
We will gladly submit suggestive lay-outs and estimates without obligation.

PORTABLE MACHINERY CO.
Conveyor Specialists
CLIFTON, NEW JERSEY



When the Boiler Breaks Down

Send for PAGE!



Page installation of 1—750 H.P. Badenhausen boiler for burning pulveried coal at the American Hair Felt Co., Newark, New Jersey
One of Page's—1,000 and more boiler brick work jobs done annually.

Page renders an unusual and important service to industries in and about New York City. In the event of a boiler breakdown Page can rush a sufficient force of experienced boiler masons to the job to effect quick and substantial repairs. FREQUENTLY, THIS HAS PREVENTED LARGE PRODUCTION AND OPERATING LOSSES RESULTING FROM STEAM PLANT SHUTDOWNS.

As the largest boiler setters on the Eastern seaboard, Page steadily employs the greatest number of skilled boiler masons 12 months in the year to handle its ever increasing volume of business. These men are distributed throughout the Metropolitan district. Page Service is so organized they can be reached at all times. Key men to direct matters are located at strategic points. On emergency calls those boiler masons nearest the breakdown can be sent quickly. Only an hour's notice is required to send materials from its several yards and a repair gang to rebuild the brickwork.

You will find many advantages in employing Page Service—dependable material, skilled workmanship, schedules maintained and moderate prices. May we estimate on your boiler masonry work?

PAGE

PAGE BAFFLE WALLS

Boiler Baffle Walls
Boiler Furnace Walls
Boiler Settings
Incinerators

SERVICE

Night Telephones for Emergency Calls:

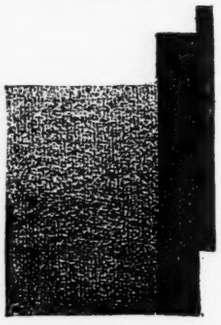
Republic 2024
Essex 2531
Scarsdale 507
Virginia 4191
Esplanade 6226
So. Orange 3816

THE FREDERICK PAGE CONTRACTING CO., Inc.

45 E. 17th St., New York City

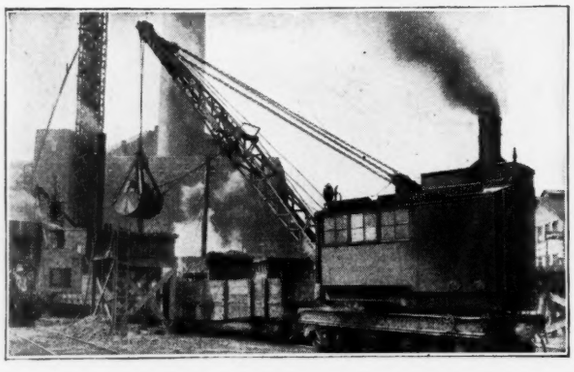
"Quality Service at the Right Price"

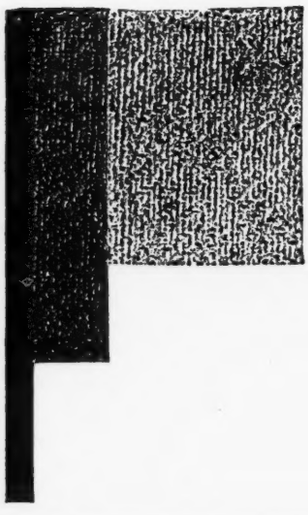
The Forty Sixer of Twenty-nine



Only four years less than a half century ago American Hoist & Derrick Company tossed her "hat" in the ring with industrial manufacturers. Development and progress followed. Engineering genius plus skilled workmanship accomplished its purpose in fostering American leadership. Today the "ringsiders" are even more emphatic in acclaiming American equipment the pace setters of modern achievements.

American Hoist & Derrick Co.
85 South Robert St., St. Paul Minn.





AMERICAN
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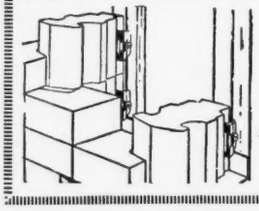
THE HOLLY GRAVITY RETURN SYSTEM
RUSSELL B. HOBSON
GREAT NOTCH, N. J.



Air Cooled Furnaces
DE WOLF CONSTRUCTION
DW
To Meet Modern Requirements
For details, see **POWER**, 1-29-29, *pg.* 159; 12-11-28, *pg.* 980. *Send for Bulletin.*
DE WOLF FURNACE CORP., Rochester, N. Y.

The
RUST ENGINEERING CO.
PITTSBURGH, PA.
CHIMNEYS—Brick and Concrete
Boiler Settings—Power Plants
New York Birmingham Washington

DURA-STIX
has achieved a dignified reputation for faithful service to industry.
Bonds and *Extends* the life of fire brick in the best known plants of America. *Booklet PH tells how.*
KEYSTONE REFRACTORIES CO., 120 Liberty St., New York

North American Refractories Co.
Manufacturers of
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The Standard for 85 Years
LACLEDE FIRE BRICK
LACLEDE-CHRISTY, ST. LOUIS, U.S.A.
Also use L-C Flat Arches and Arch Tile MR656

The BECO will save 3% of your fuel.

Gas leakage through the BECO is impossible.

HOW TO BUILD BOILER BAFFLES
Unless boiler baffle walls are provided with positive expansion joints they will surely crack. Solid monolithic walls are always unreliable. They crack for the same reason that solid concrete walks and roads invariably crack. Expansion joints are necessary.

The BECO Corrugated Sheet Metal Separator, shown above, makes cracking impossible. Send sketch of your boiler for quotation.

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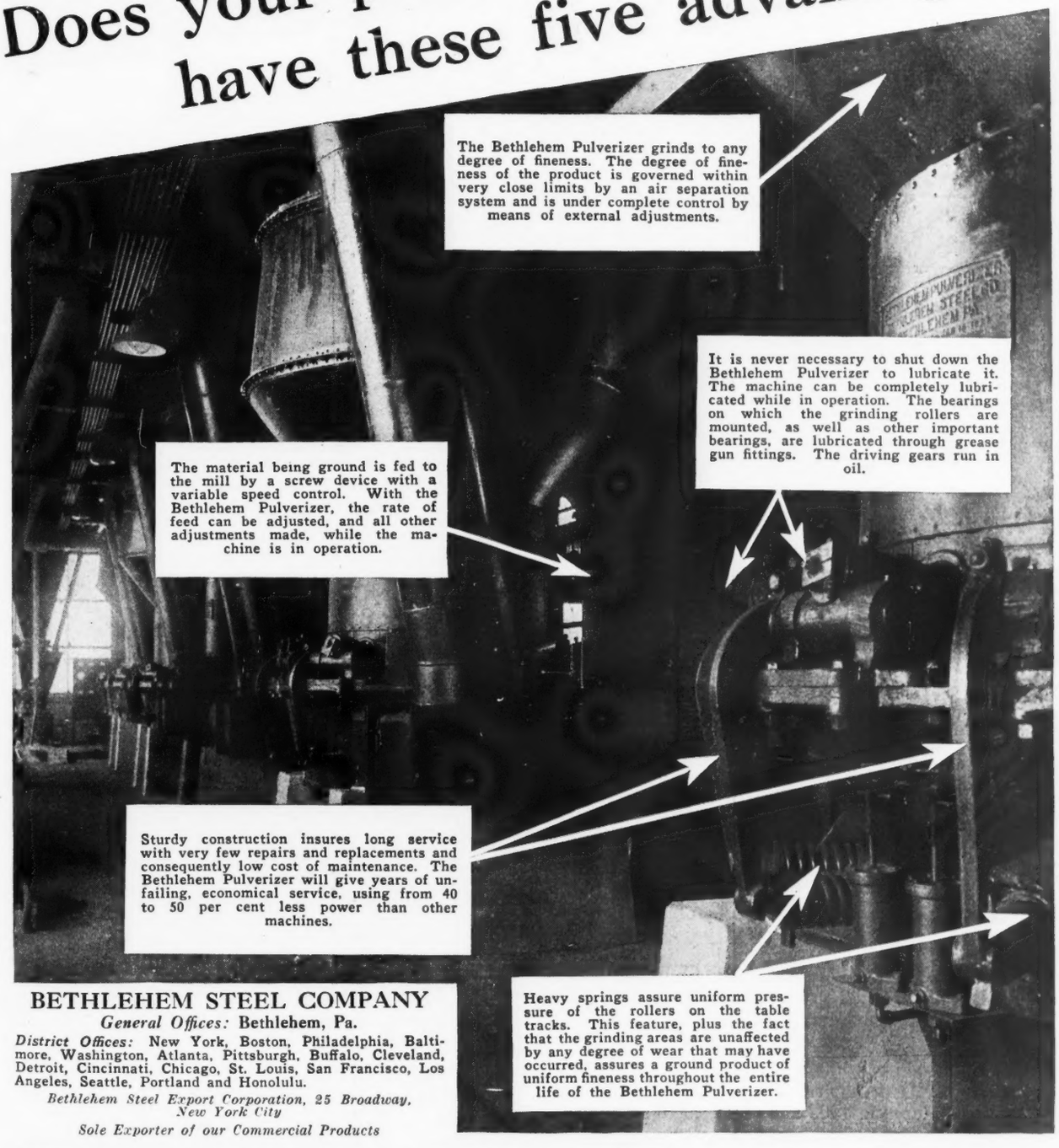
931 Federal Trust Bldg., Newark, N.J.

High Temperature Cements
FIREBOND THERMOLITH
REFRACTORIES
Fire Clay High Alumina Silica Chrome and Magnesite
Acid-Proof Brick
HARBISON-WALKER REFRACTORIES COMPANY
World's Largest Producer of Refractories PITTSBURGH, PA.

Does your pulverizing equipment have these five advantages?



The Bethlehem Pulverizer grinds to any degree of fineness. The degree of fineness of the product is governed within very close limits by an air separation system and is under complete control by means of external adjustments.

It is never necessary to shut down the Bethlehem Pulverizer to lubricate it. The machine can be completely lubricated while in operation. The bearings on which the grinding rollers are mounted, as well as other important bearings, are lubricated through grease gun fittings. The driving gears run in oil.

The material being ground is fed to the mill by a screw device with a variable speed control. With the Bethlehem Pulverizer, the rate of feed can be adjusted, and all other adjustments made, while the machine is in operation.

Sturdy construction insures long service with very few repairs and replacements and consequently low cost of maintenance. The Bethlehem Pulverizer will give years of unfailing, economical service, using from 40 to 50 per cent less power than other machines.

Heavy springs assure uniform pressure of the rollers on the table tracks. This feature, plus the fact that the grinding areas are unaffected by any degree of wear that may have occurred, assures a ground product of uniform fineness throughout the entire life of the Bethlehem Pulverizer.

BETHLEHEM STEEL COMPANY

General Offices: Bethlehem, Pa.

District Offices: New York, Boston, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh, Buffalo, Cleveland, Detroit, Cincinnati, Chicago, St. Louis, San Francisco, Los Angeles, Seattle, Portland and Honolulu.

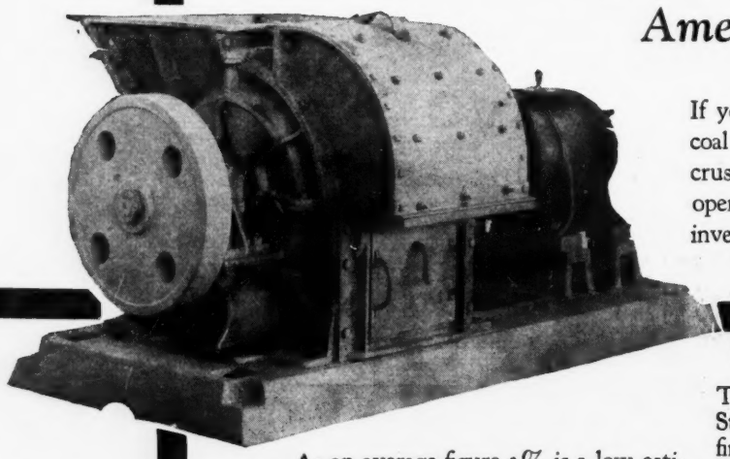
Bethlehem Steel Export Corporation, 25 Broadway, New York City

Sole Exporter of our Commercial Products

BETHLEHEM
PULVERIZER

Is 3% of your coal worth saving?

Fuel economy begins with an American Ring Crusher



If you could save as high as 3% of your coal at a cost of less than 2c. per ton for crushing, including labor, maintenance, operation, depreciation, and interest on investment, would it pay you to do it?

Improved No. 24 "S" type American Ring Crusher Timken equipped, mounted on heavy bed plate with direct connection to motor.

As an average figure 3% is a low estimate of the possible saving that can be made where fuel requirements are determined on the basis of boiler efficiency and American Ring Crushers used to produce properly sized and uniform fuel.

The Patented Reversible Manganese Steel Shredders and Scraper Rings keep fines down to a minimum because they split the coal instead of crushing it. An adjustable eccentric grinding plate makes it possible to obtain any size fuel desired.

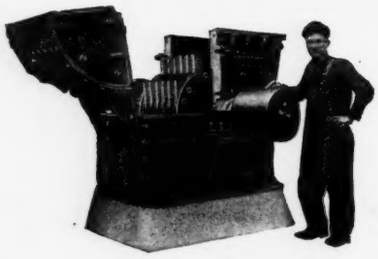
Performance data will be gladly mailed you upon request.

ORIGINATORS OF THE ROLLING RING CRUSHER PRINCIPLE

AMERICAN PULVERIZER CO

1249 MACKLIND AVE. ST. LOUIS, MISSOURI

GRUENDLER



Coal Crushers

At a gross cost of 2 cents a ton, Gruendler Coal Crushers will crush and prepare your coal for stokers and unit pulverizers.

Gruendler Crushers require little or no attention. Crush uniformly, increasing efficiency of stokers and unit pulverizers. These crushers were developed in 1908 and perfected to their present leading position.

Compact, sturdy construction, economy of floor space are other features of the Gruendler. Built in any size from 10 tons daily to 10,000 daily.

GRUENDLER
CRUSHER & PULVERIZER CO.
2915 N. Market St., St. Louis, Missouri

Specially Engineered Pumps

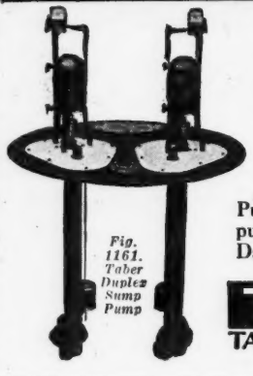


Fig. 1161. Taber Duplex Sump Pump

Where a Taber standard SUMP, sewage, centrifugal, or rotary pump cannot be used, a Taber specially engineered pump will meet the requirements.

Put your pump problems up to pump engineers. Write for Taber Data Sheet and Bulletins.

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TABER PUMP CO. *Est. 1859*

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INDUSTRIAL BROWNHOIST

Locomotive Cranes
Chain Conveyors
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ASH SLUICING SYSTEMS

Cast Iron Ash Hoppers~Tanks~Coal Bunkers
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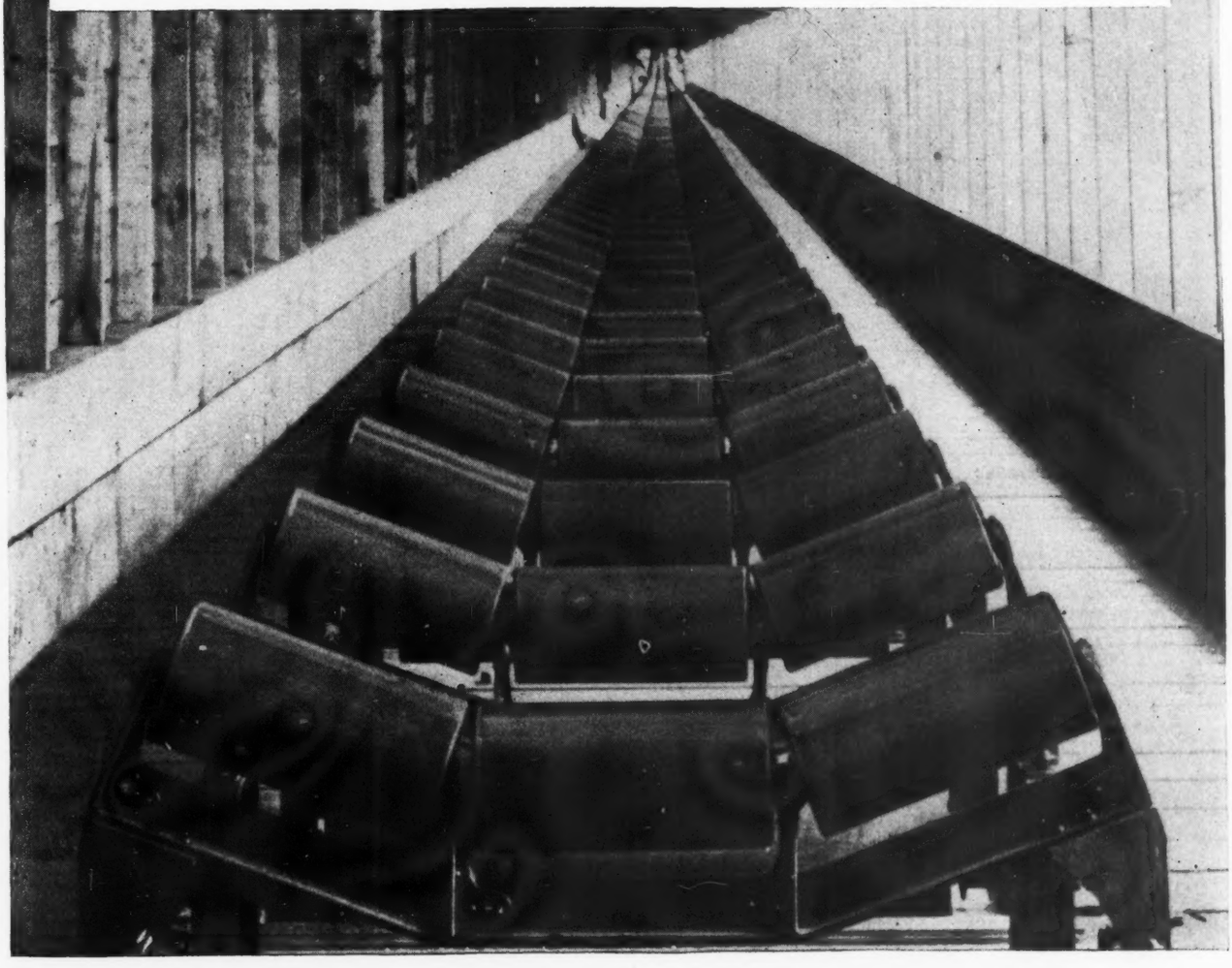
Strength — Rigidity — Uniformity

Characteristics of Link-Belt Belt Conveyor Idlers

RESULTS: standardization of a proven design, increased belt life—lower maintenance and handling costs.

Lowest cost per ton of material handled is always the ultimate objective. A trial order will convince the most skeptical, as it has our present users, that Link-Belt Anti-Friction Belt Conveyors handle material at the lowest cost per ton.

Use belt conveyors that produce most for your dollar. Send for a copy of Belt Conveyor Data Book No. 615.



LINK-BELT COMPANY 3722

Leading Manufacturers of Elevating, Conveying, and Power Transmission Machinery and Chains

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Dallas, Texas - 1101 Mercantile Bank Bldg.
Denver - - - - - - - 520 Boston Bldg.
Detroit - - - - 5938 Lindale Ave.
Grand Rapids - 536 Michigan Trust Bldg.
Kansas City, Mo., R. 436, 1002 Baltimore Ave.
Los Angeles - - 361-369 S. Anderson St.
Louisville, Ky. - - - 349 Starks Bldg.
Milwaukee - - R:1403, 425 E. Water St.
New Orleans - - - - 619 S. Peters St.
New York - - - 2676 Woolworth Bldg.
Oakland, Calif. - - - - 526 Third St.
Pittsburgh - R. 2125, 436 Seventh Ave.
Portland, Ore. - - - - - 67 Front St.
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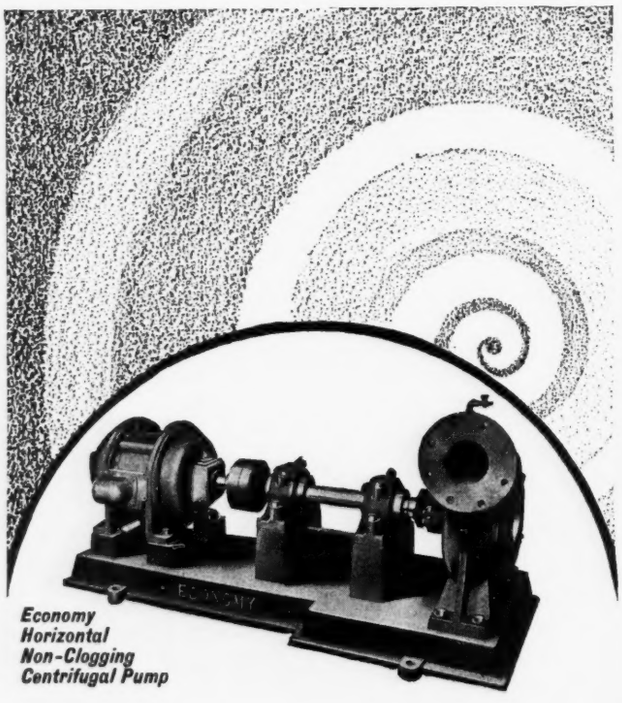
LINK-BELT

ANTI-FRICTION BELT CONVEYOR

21 YEARS OF SUCCESS AS SPECIALISTS IN
CENTRIFUGAL PUMPS



Economy Horizontal Non-Clogging Centrifugal Pump

Sound engineering, good materials, and responsible service have built their solid reputation.

For details on standard models, send for bulletins.

ECONOMY PUMPING MACHINERY COMPANY
3431 West 48th Place ▲ Chicago

Representatives in principal cities—telephone and address under company name

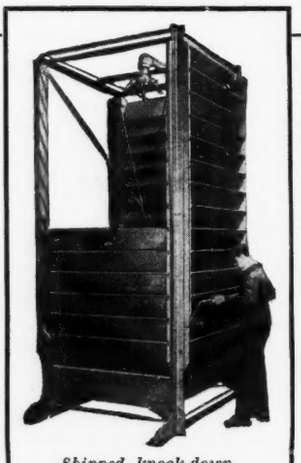
Economy Pumps

All standard types—also specially designed pumps to meet any condition

BINKS

SPRAY COOLING TOWERS

are making good everywhere!



Shipped knock-down. Quickly assembled.

This unit type tower is for Diesel engines, compressors, small refrigeration plants, etc., where water to be cooled is not over 100 gallons per minute. For larger capacities, or as needs develop, units may be added. Space required only 6 ft. x 7½ ft. Use with or without collecting basin;—on roof or ground. Permanent construction. Many in use. Write for "Bulletin 5-E."

BINKS MANUFACTURING CO.
3122 Carroll Ave.
Chicago, Ill, U. S. A.

Read What This User Writes:

This tower seems to be doing an unbelievable amount of work for the amount of space which it takes up and before same was installed some of the engineers seemed to think that it was not half large enough, but we have found that it is the most satisfactory cooling tower we have ever had any experience with.

NASHVILLE MACHINE & SUPPLY CO.
M. L. Gossett, Supt. Refg. Dept.

JAMES M. SEYMOUR, Inc.
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CYCLONIC COOLING

COOLING TOWERS

"Water Saved Is Money Made"

Seymour Cyclonic Cooling Tower Features:

1. MAXIMUM COOLING.
2. MINIMUM MAKE-UP WATER.
3. SUCTION TYPE FANS—NO ICE TROUBLE.
4. ALL SIZES UP TO 5000 G.P.M.
5. RESULT OF 43 YEARS' COOLING TOWER EXPERIENCE.

YARWAY

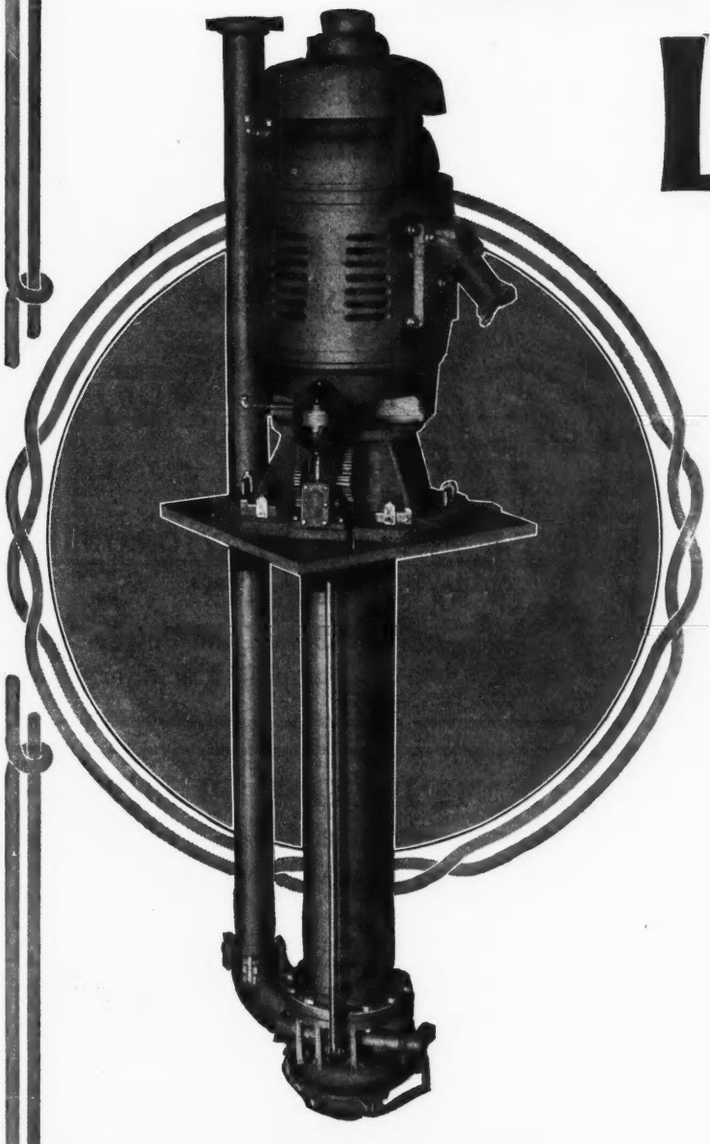
INVOLUTE SPRAY NOZZLE

Spray Cooling Equipment. Send for Booklet N613.
YARNALL-WARING CO., Mermaid Ave., Phila.

MARLEY SPRAY NOZZLES

CATALOG ON REQUEST
THE MARLEY CO., Kansas City, Mo.

Pumping molten LEAD



Lowered into a melting pot, this Byron Jackson Pump will handle 25 tons of molten lead, 850° Fahrenheit, per hour. Flow is regulated by means of a throttling valve on the suction end, driven by small electric motor and gear mechanism, here shown. This pump will do in a few minutes what formerly required hours with a large crew of men. Byron Jackson has always been noted for special equipment designed to meet unusual conditions. In addition to these units, this company builds a complete line of standard pumps for service in mines, smelters, waterworks, leaching and industrial plants of all kinds.

SINCE 1872

BYRON JACKSON CO.

Factories: BERKELEY, Los Angeles, Visalia, Calif.

Branches: NEW YORK and CHICAGO
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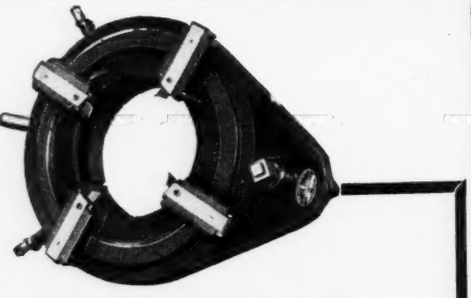
BYRON JACKSON

CENTRIFUGAL PUMPS FOR EVERY SERVICE



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—with a "TOLEDO" Automatic Pipe Cutter easily, quickly and perfectly. "TOLEDO" No. 40 capacity 2 in. to 4 in., No. 80 capacity 4½ in. to 8 in., operated either by hand or a "TOLEDO" Power Drive. They eliminate all trouble in cutting off large pipe.

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BOILEF DRUMS....HEADERS....RECEIVERS
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All Kellogg Piping Products are insurable

PIPE BENDS
WELDED HEADERS
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COMPLETE POWER PIPING

Geo B LIMBERT PIPING & Co
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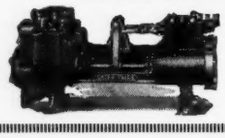
Engineering experience and plant facilities are the cornerstone of service in pipe fabricating. In both these particulars Grinnell is pre-eminent.
Address inquiries to Providence, R. I.
GRINNELL COMPANY

PLATT IRON WORKS - DAYTON, OHIO.
Smith-Vaile PLATT Pumps



Steam and Power Pumping Machinery

SEWAGE EJECTORS - CENTRIFUGAL PUMPS - AIR COMPRESSORS
Jennings Pumps
NASH ENGINEERING CO. SOUTH NORWALK, CONN.

CENTRIFUGAL PUMPS
Capacities to 30,000 G.P.M.—Heads to 1,500 ft.
LC LECOURTENAY LC
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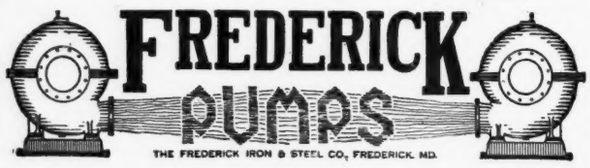
RoTURBo CENTRIFUGAL
PUMPS
Manisteelron Works Co., Manistee, Michigan



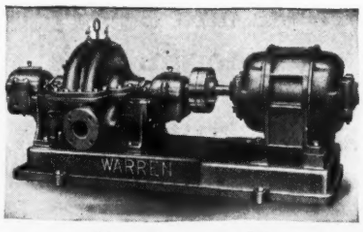
Surface Condensers, Jet Condensers, Barometric Condensers, Leach Fracto Control Condensers, Oil Vapor Condensers for High Vacuum Distillation, Heat Exchangers, Sand Separators, Radojet Air Pumps for vacua up to 29.95 inches, Forced and Natural Draft Cooling Towers.

C. H. WHEELER MANUFACTURING COMPANY
19th St., Lehigh and Sedgley Aves. Philadelphia, Pa.
C. H. WHEELER of PHILADELPHIA

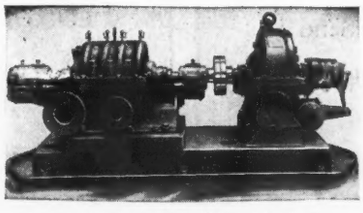
113 today three years ago 2

In 1926 a large mill installed 2 Warren Centrifugal Pumps, put them to work handling liquid carrying solid matter in suspension. Their dependable service and economical operation brought continued repeat orders . . 113 Warren Pumps are now in daily operation in this and other mills operated by the same company.

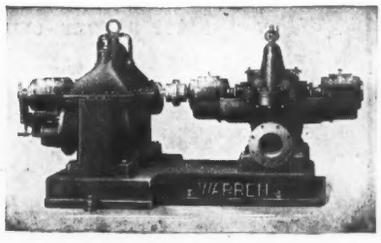
The experience of this mill is typical of many other plants that have placed repeat orders for 1 to 65 pumps as a result of the performance of their first Warren Pumps. Improved design and construction, not found in other pumps, are responsible for the sustained high efficiencies, low operating and maintenance costs. Send for Bulletins giving complete information.



Two stage, motor drive



Four stage, turbine drive



Single stage, turbine drive

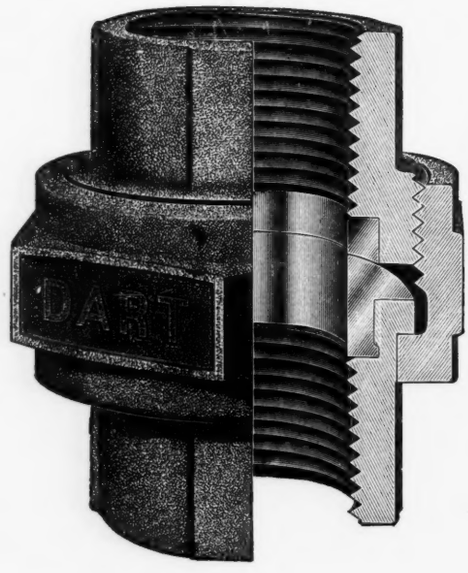
Warren

Steam Pump Company Inc.

WARREN

Warren Massachusetts

AGENCIES IN ALL PRINCIPAL CITIES



1 = 2

One Dart Union will last as long as two ordinary unions. Unions last no longer than their seats. Dart Unions last twice as long as others because of the two bronze-to-bronze seats, which make up easily to a permanently tight, corrosion-proof joint.

Why buy two unions when one Dart Union will last as long as both?

Every DART Union is guaranteed. We will replace any Dart Union proving defective in material or workmanship with two perfect Dart Unions without charge.

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Without charge or obligation, send 32-page illustrated catalogue and sample **Dart** union to try.

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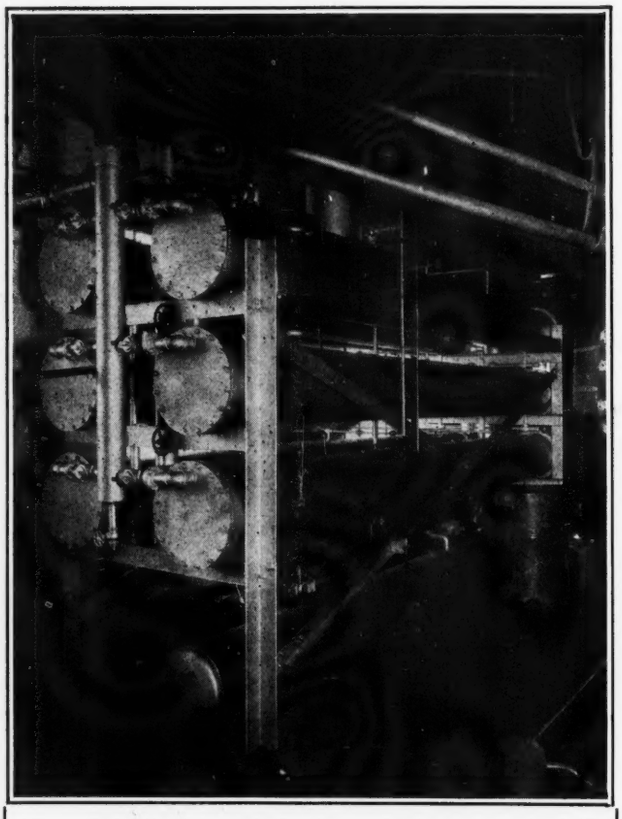

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116 tons more ice and $49.57 less money per month. It's worth investigating.

Ask about some of our installations and satisfied purchasers."

We also manufacture for the Refrigerating Industry:

Self Contained Unit Condenser Receiver Bases
Continuous Electric Butt Welded Coils
Headers, Accumulators, Receivers
Horizontal Multitubular Condensers
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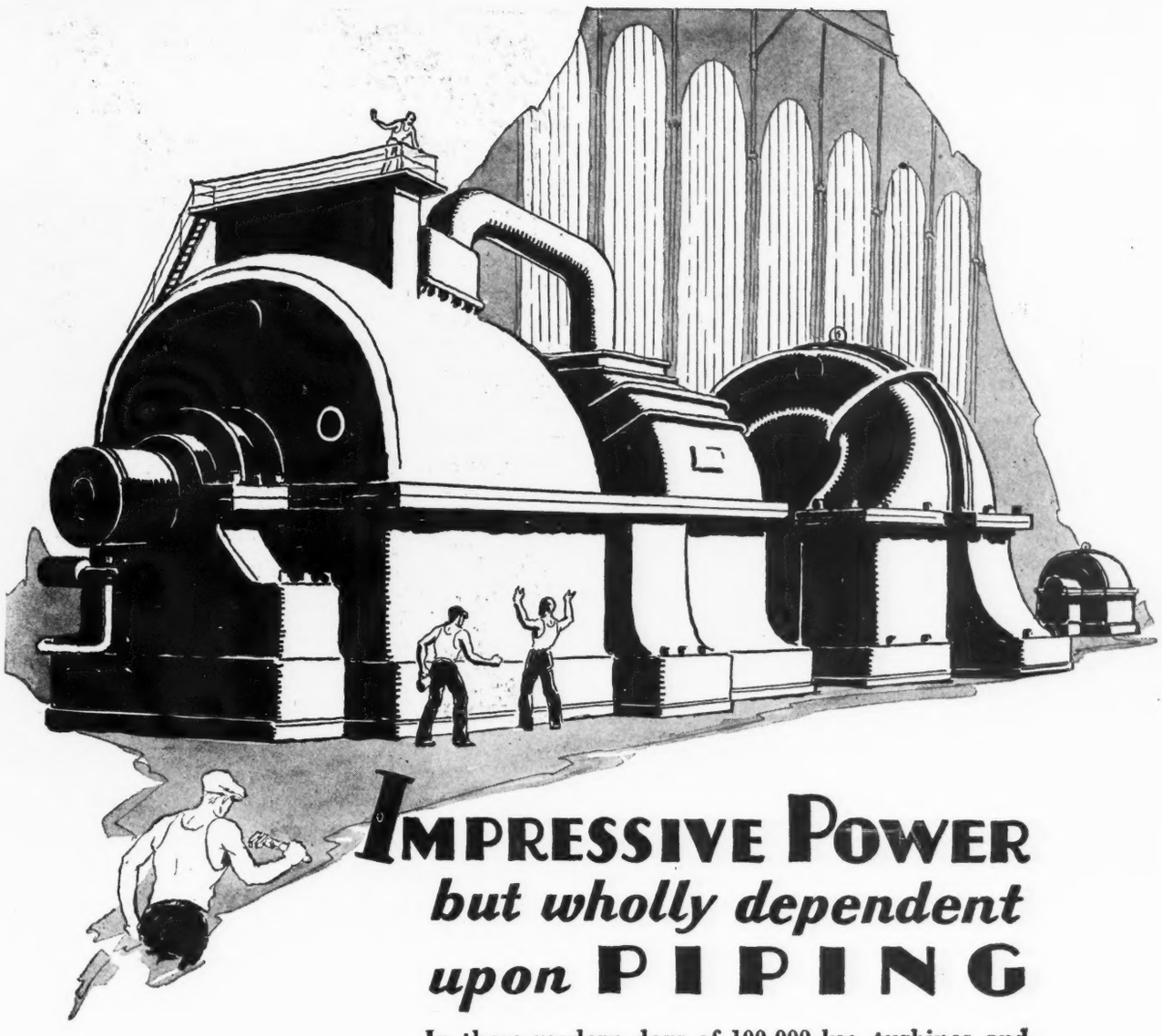
Special Pipe Assemblies
Oil and Scale Traps

ACME WELDED PIPE & COIL CO.

JACKSON, MICH.



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but wholly dependent upon PIPING

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The fact that one hundred years of skilled experience backs every length of "Etna" Welded Steel Pipe, and the fact that generations of engineers have used and preferred this time-perfected product are good reasons why you too can place the utmost confidence in "Etna" Quality Welded Steel Pipe.

If you require a seamless pipe, you will find "Standard" Seamless Power Piping equally dependable.

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ADSCO VARIATORS
Packless Expansion Joints for pressures up to 125 lbs.

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ADSCO Variators are used for practically every conceivable low-pressure service in conveying steam, air, gases and various other liquids.

Their flexible diaphragms permit easy expansion of the line, thus they are particularly adapted for underground mains where years of service without maintenance is vitally essential. Thousands of ADSCO Variators installed 15 to 35 years ago are still in service today without ever having been touched! Use the coupon below.

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P. 6

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Will reduce from any pressure to any pressure in one reduction. It is also a dead end valve.

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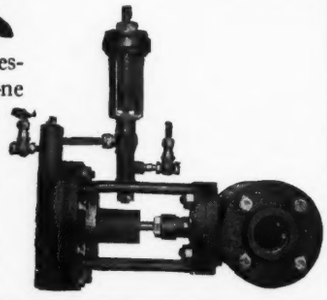

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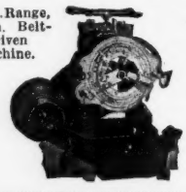

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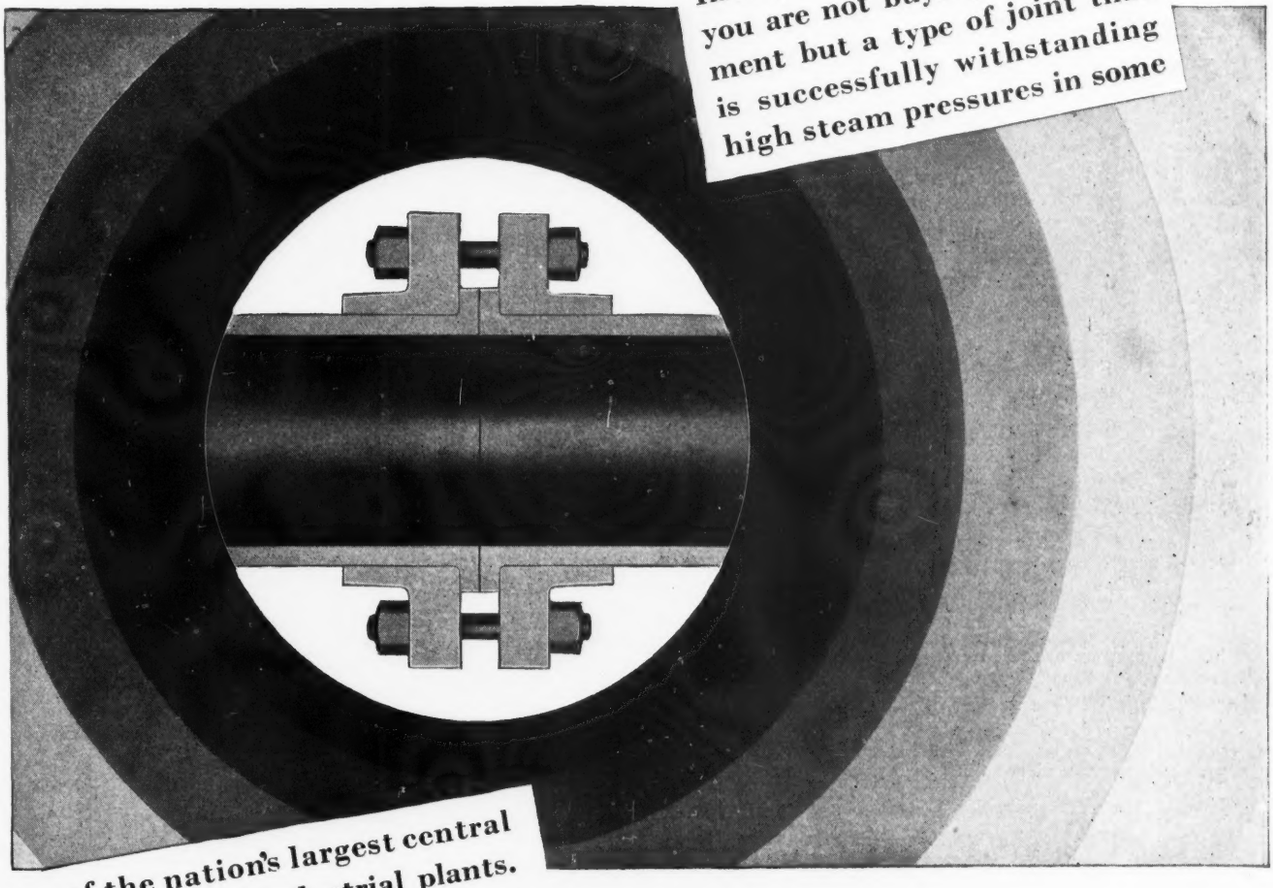

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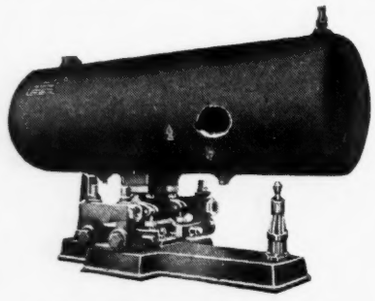

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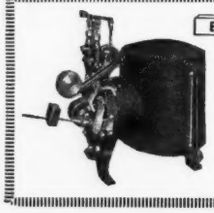

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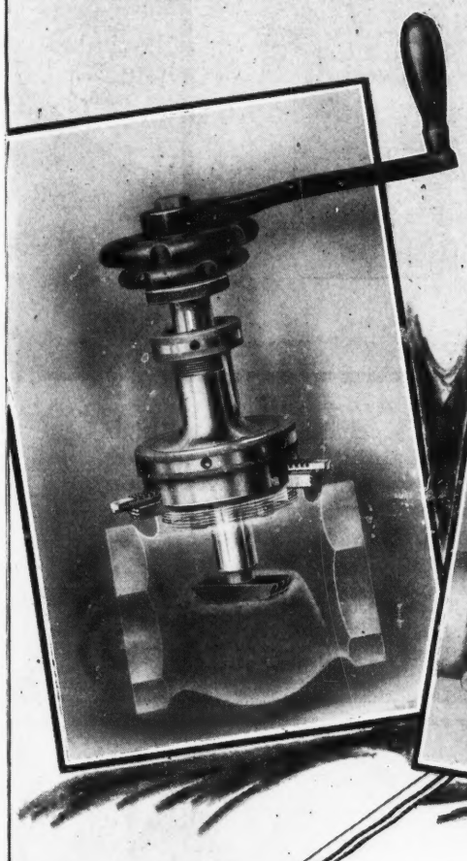

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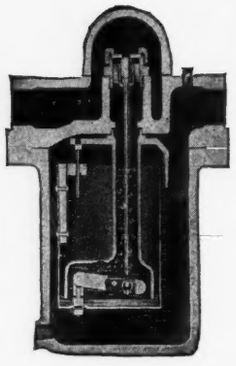

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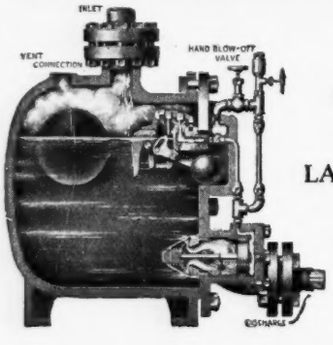

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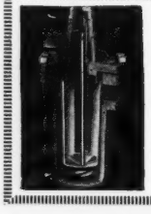

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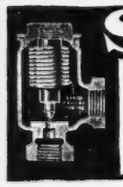

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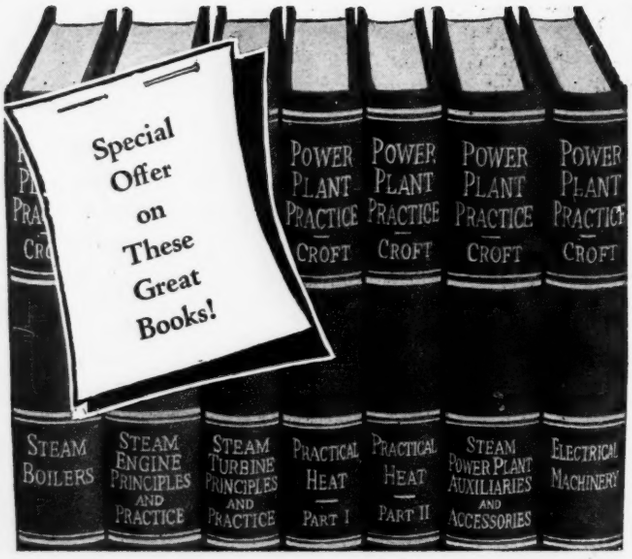
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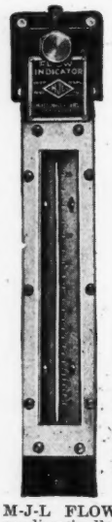

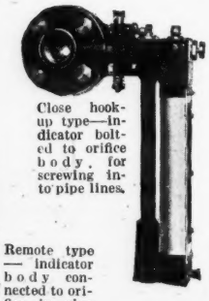

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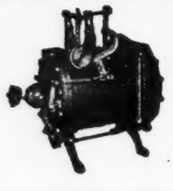

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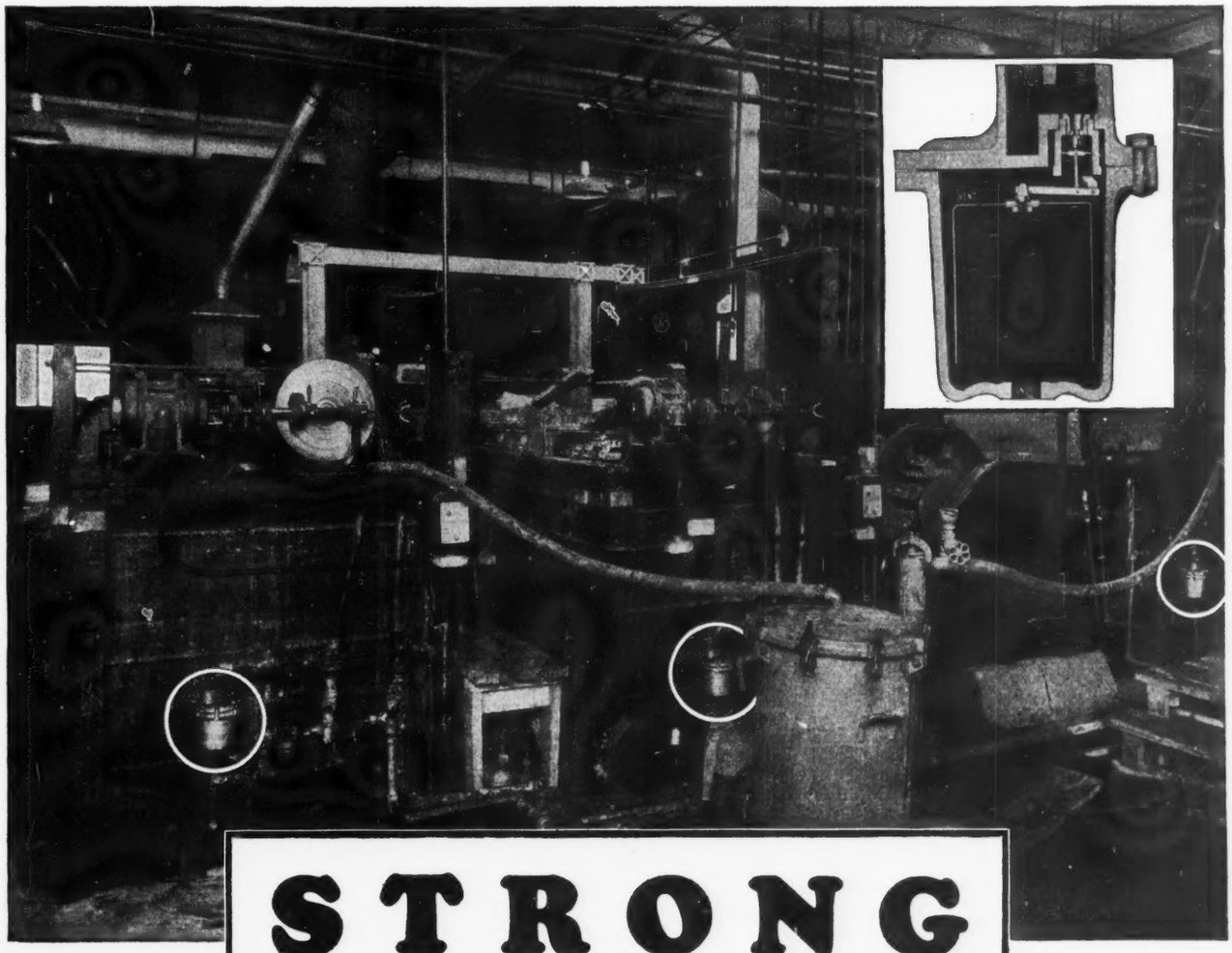

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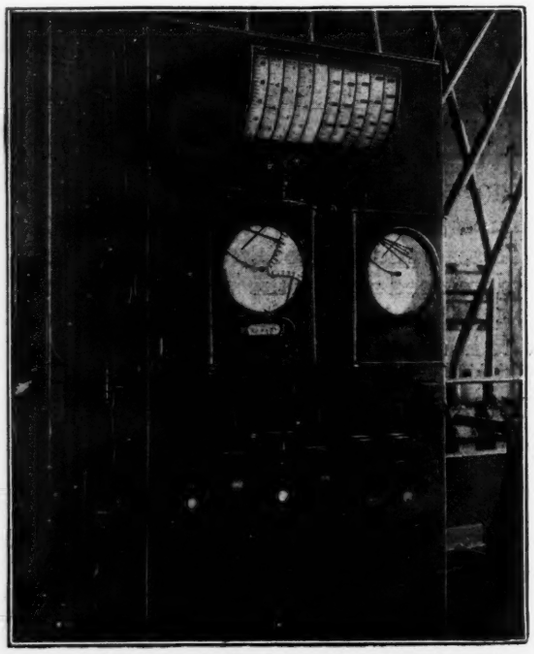

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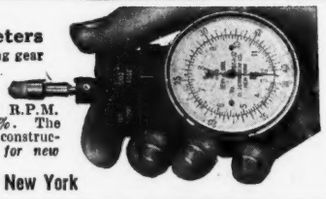

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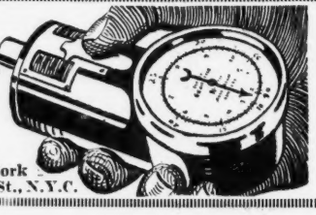

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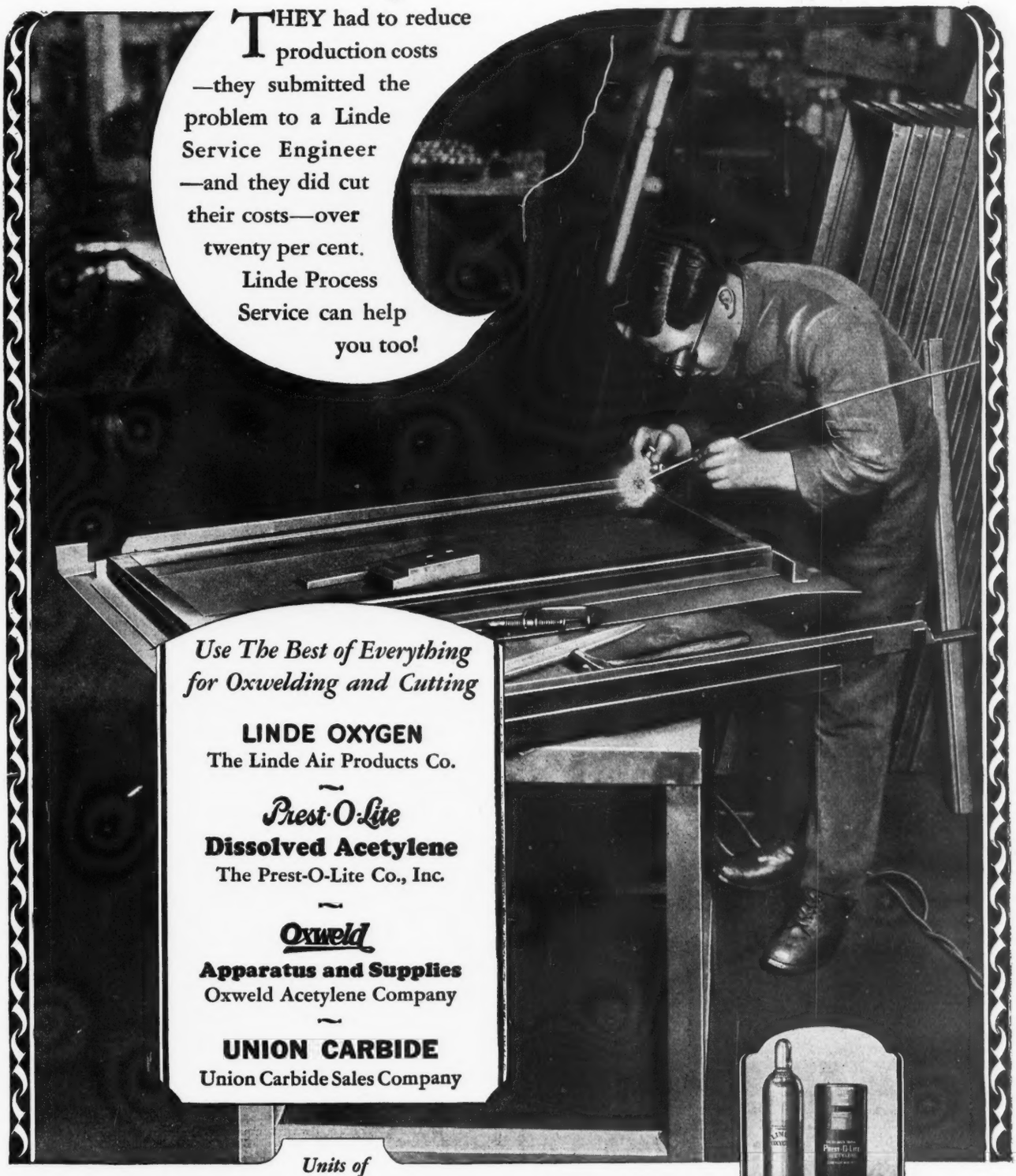

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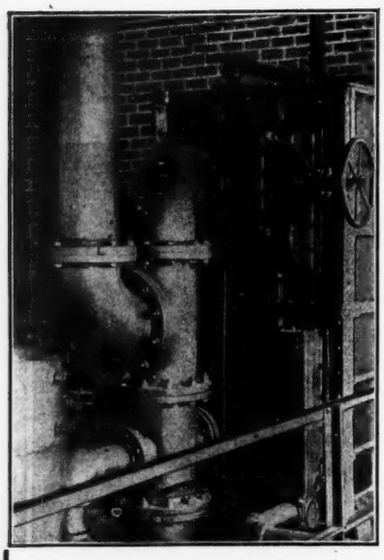

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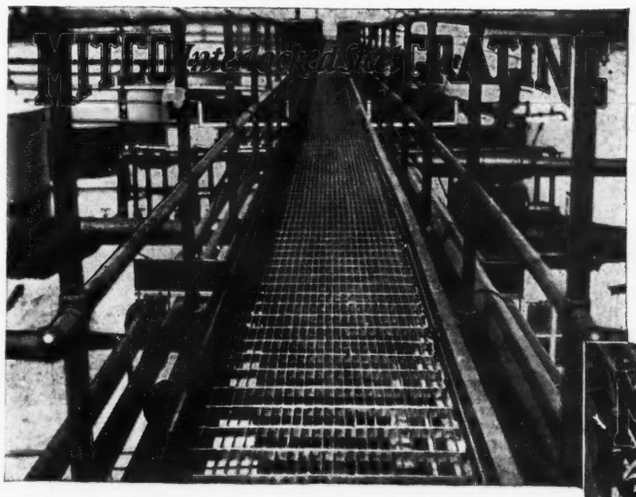

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To prevent crack-outs and premature wear in floors, platforms, ramps and driveways, reinforce them with Mitco Armorgrids. They are set on the rough slab, with the finishing fill of concrete (or other flooring material) bringing the surface flush with the top of each Armorgrid panel. Write for a copy of the Mitco Armorgrid bulletin.

WHEREVER you need open flooring, you can specify Mitco with the confidence that it will meet every requirement. Possessing the high strength and permanent rigidity necessary to withstand heavy loads and shocks, Mitco Interlocked Steel Grating is non-slipping because it is made of square-edge steel bars on which the feet get a better grip. Mitco is also non-clogging, because its openings are rectangular, with no acute angles to catch and hold the dirt and refuse. In addition, the rectangular openings of Mitco provide 90% open area, giving maximum light and ventilation.

On stair steps, ladders and fire escapes, Mitco Shur-Site Treads provide greater safety. They are made of 1" Type C Mitco Grating, with the same non-slipping, non-clogging surface and rectangular openings. The edge of every Mitco Tread is very clearly defined by means of a deep nosing bar, bent back at an angle under the front of the step, making each edge highly visible and preventing falls caused by overstepping the front edge. The nosing bar is self-clearing, and there is no pocket to collect dirt, snow or ice.

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"Have used our Fort Douglas XX for 29 years. Have tried many other kinds of oil but always found ours gave the best service."

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Goodrich Maxecon Belting 60-inch 8-ply Highflex construction was specified for this modern coal handling plant of the Western Maryland Railway Co., Port Covington, Baltimore, Md., designed and installed by Wellman-Seaver-Morgan Co., Cleveland, Ohio.

A belt that is fortified *against injury and gouging*

Highflex Principle brings new strength to the most vulnerable part of a belt

THE remarkably long life of Goodrich conveyor belts is the result of their unique construction. This Highflex construction makes belts endure under conveyor service conditions that quickly sap the strength of ordinary belts.

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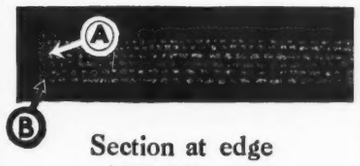
We will gladly send additional information. Write to The B. F. Goodrich Rubber Company, Est. 1870, Akron, O. (In the West, Pacific Goodrich Rubber Co., Los Angeles, Cal.) or fill in the coupon below.



Section at edge of Highflex belt

A—Each ply a separate unit—no folds

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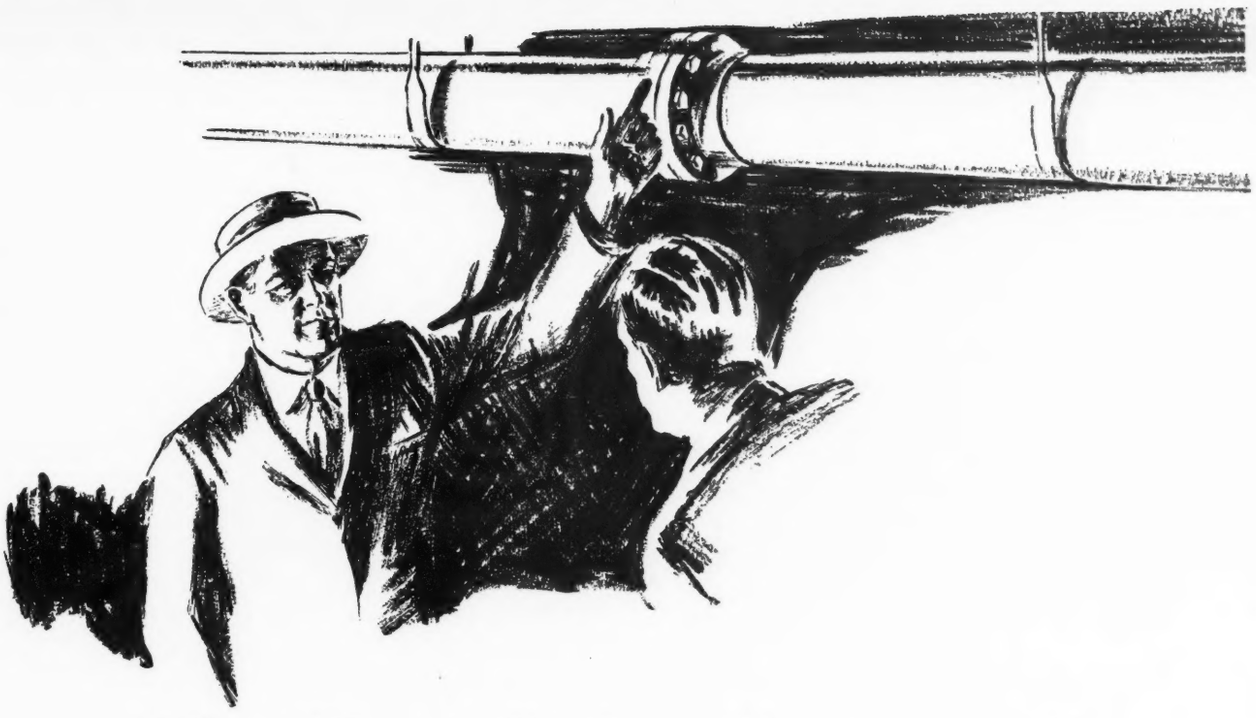

The "Super" gives Jimmy a tip on Keeping Air Lines tight

"I saw you an the Super havin a session out alongside the big air line today," says I to Jimmy after we had finished our lunch an was lightin up. "Did he have anything special on his mind?"

"You tell em," says Jimmy. "He got wise to them leaky joints that Scanlon left behind him, and wants em fixed pronto." "That's easy said," says I, "but Scanlon tried everything on them joints an you'll have the same trouble. The gasket ain't made that'll hold air against that combination of heat, high pressure and vibration. The oil rots em out, too."

"I told him that," says Jimmy, "but he says that's a lot of boloney. Use Dixon's Graphite Seal, he says, an you'll have no trouble. Paint the gasket good all over with it an pull the flanges up tight. The oil won't touch it; an the heat only makes it expand a little and stay expanded. Use it on all your flanged or threaded connections except for water or low pressure steam."

"What's the matter with usin it for them, too," says I? "Not so hot for them," says he, "because it dissolves in warm water. That's how you take the joints apart when you want to. It'll soften up with warm water so you can get the gaskets off without hurtin them."

The "Super" knows his stuff. Dixon's Graphite Seal is the best yet for making joints permanently tight against Air, Vacuum, Gas, Vapor (non-aqueous) High-Pressure Steam, Hot or Cold Oil, Gasoline, etc. Thinned with water for use—does not discolor, contaminate, flavor or ferment. Write for circular No. 94-DS and get the whole story.

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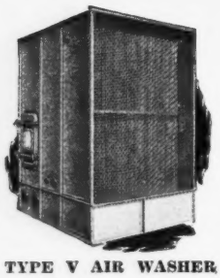
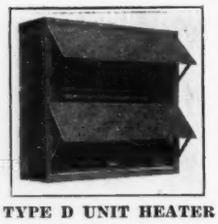
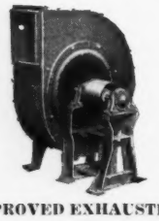


TYPE V AIR WASHER



TYPE D UNIT HEATER



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The trifle more you may be called upon occasionally to pay for fans, blowers, unit heaters, air washers or similar equipment built by Clarage is money well spent.

You can expect efficient performance and long service life from Clarage equipment. You can expect results. You can expect that overhauls and repairs will be few and far between—maintenance hardly ever more than a good job of lubrication. In short, you can expect as one engineer expressed it, "The best d——n fan equipment offered today."

Here is a dependable source of supply covering all requirements in factory unit heating, air conditioning, mechanical draft, ventilation, exhausting, and high or low pressure blowing. Make use of our facilities! Write for Catalogs. Without obligation, consult with Clarage engineers.

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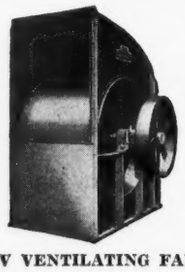
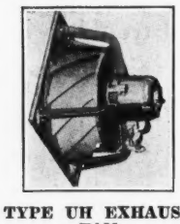


HV VENTILATING FAN

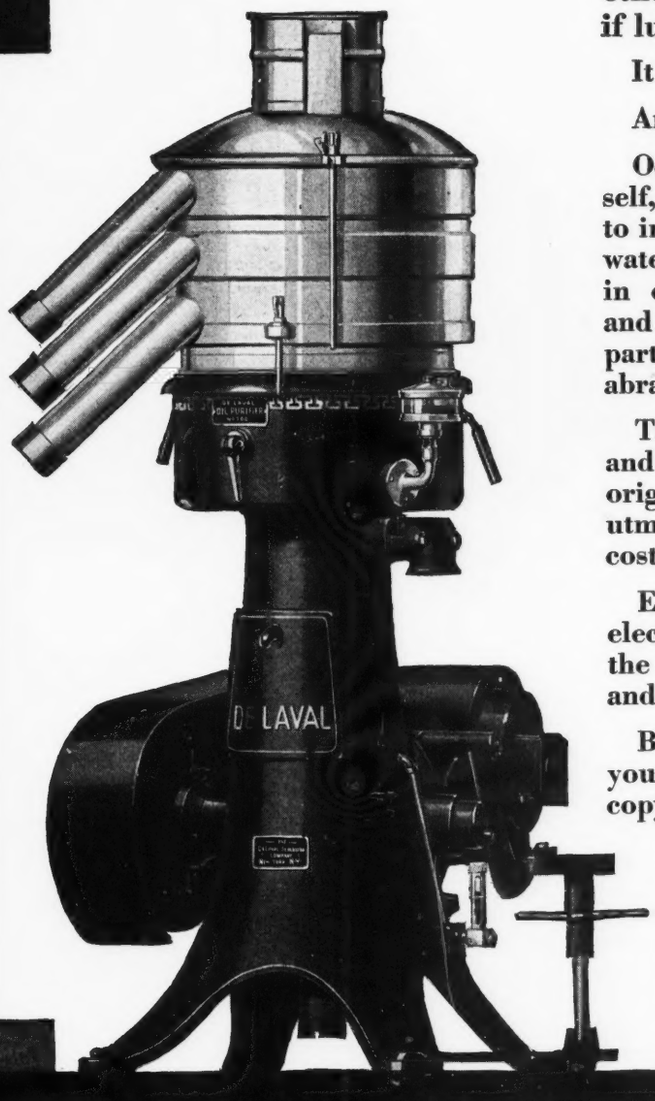


TYPE UH EXHAUST FAN

HIGH SPEED BLOWER

Fans — Blowers — Air Washers — Unit Heaters

THE BEARING DOESN'T FAIL



TRUE ENOUGH, one bearing may stand more punishment than another, but no bearing can long survive if lubrication is inefficient.

It is the oil that fails—not the metal!

And what causes oil to fail?

Occasionally the fault is with the oil itself, but far more often the trouble is due to impurities which it picks up in service: water which leads to detrimental change in chemical composition, emulsification and rapid formation of sludge; abrasive particles which puncture the oil film and abrade the bearings.

The De Laval Oil Purifier keeps oil clean and dry . . . . indefinitely maintains its original lubricating qualities . . . . assures utmost bearing protection at minimum cost.

Eighty-eight per cent of America's greatest electric power systems have given De Laval the task of keeping lubricating oil clean and dry.

Bulletin No. 106-P tells how and why you should do the same. Write for your copy today.

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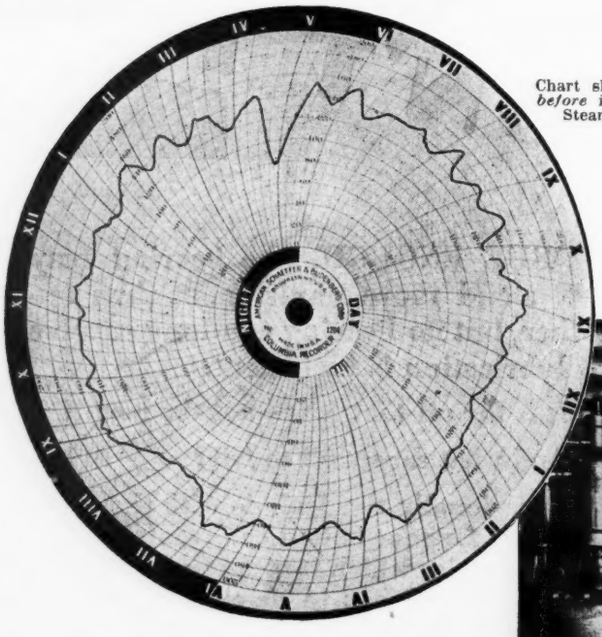
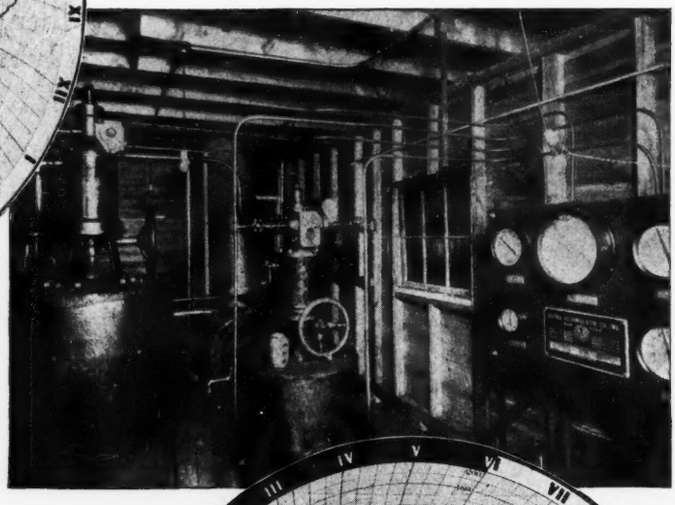


Chart shows boiler pressure *before* installation of Ruths Steam Storage System.

Equipment providing automatic control of a Ruths Steam Storage System.



Steady boiler operation . . . in spite of peak loads

Peak steam demands will not affect the efficient operation of your boiler plant when you have a Ruths Steam Storage System. This system permits the operation of your boilers at constant pressure and at a constant firing rate to meet the average steam demand only.

Fluctuations in steam load are quickly absorbed by the Ruths Steam Storage System. You do not have to force the boilers to meet sudden peak demands for steam.

Maximum, low-cost non-condensing power is also available. There are other advantages that should interest you—ask about them.

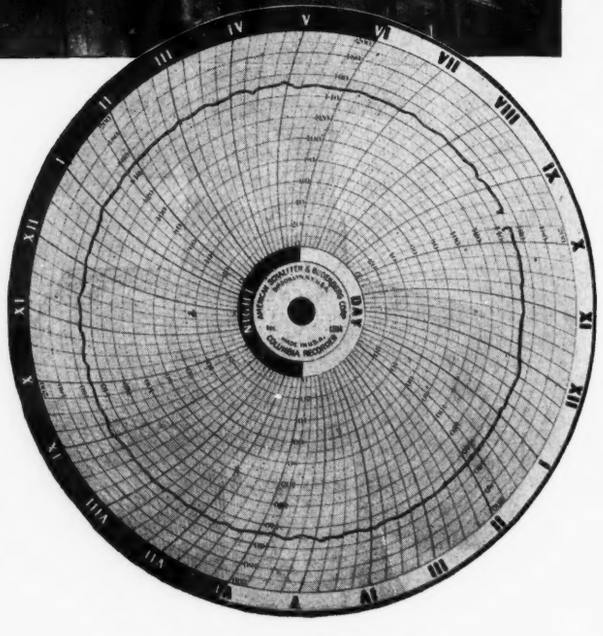


Chart shows boiler pressure *after* installation of Ruths Steam Storage System.

3756

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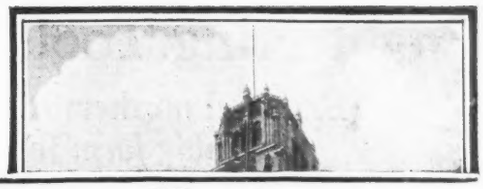

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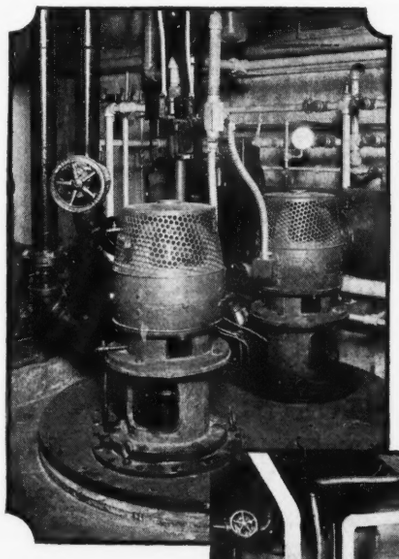
There's probably no one reason for the trend to Dayton-Dowd pumping equipment, used in the large 30 to 40-story buildings now appearing on the skyline of every large city.

Features of design in the equipment influence the choice in many instances—the hydraulically balanced design of house pumps and fire pumps, the non-clogging features of ejectors, etc.—but more than this and of greater importance is the complete line of centrifugal pumps offered and the experience and service available in the Dayton-Dowd organization.

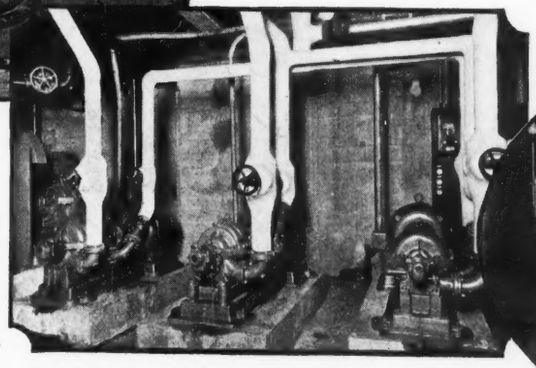


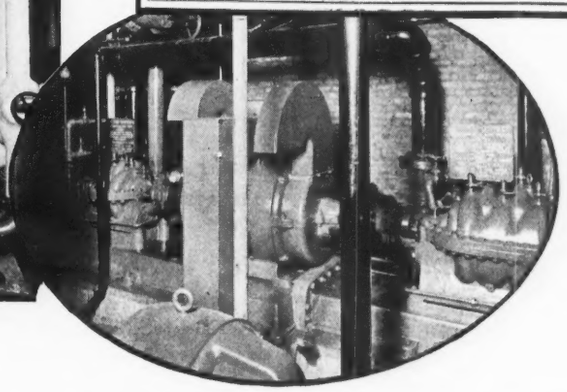
Willoughby Tower Equipment—

LEFT—Dayton-Dowd 4-in. DUPLEX EJECTOR delivering 250 g.p.m. against 45 ft. head drive—7½ hp. motors.

BELOW—2 Dayton-Dowd 2-in.—4-stage HOUSE PUMPS, each 75 g.p.m. against 490 ft. head connected thru flexible coupling to 30 hp.—1750 r.p.m. motors. One Dayton-Dowd 2½-in.—3-stage pump, 250 g.p.m. against 350 ft. head direct connected to 40 hp. motor.

IN OVAL—750 gallon pump—direct connected to 150 hp. motor with double extended shaft with 500 gallon pump. Taking suction from first total pressure 269 pounds.





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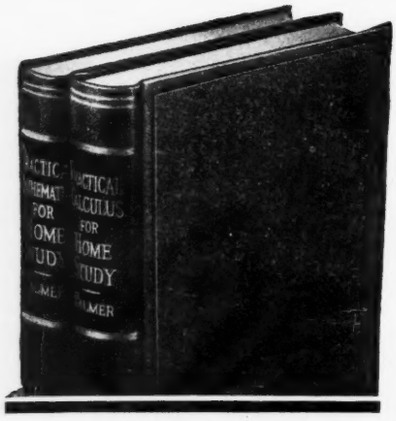

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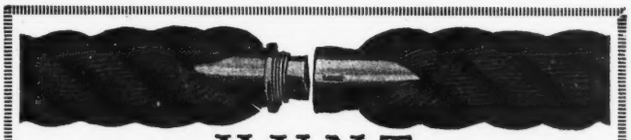

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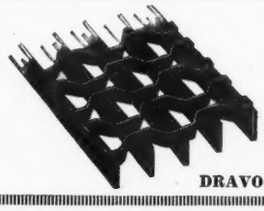

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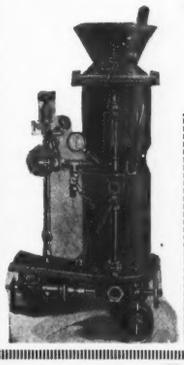

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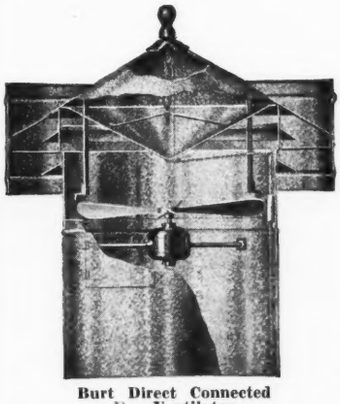

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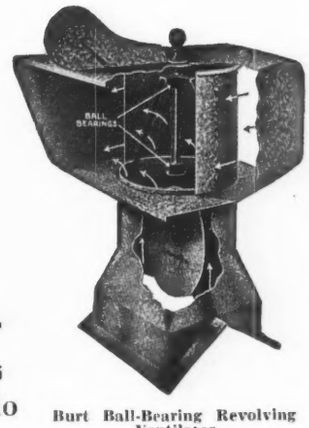

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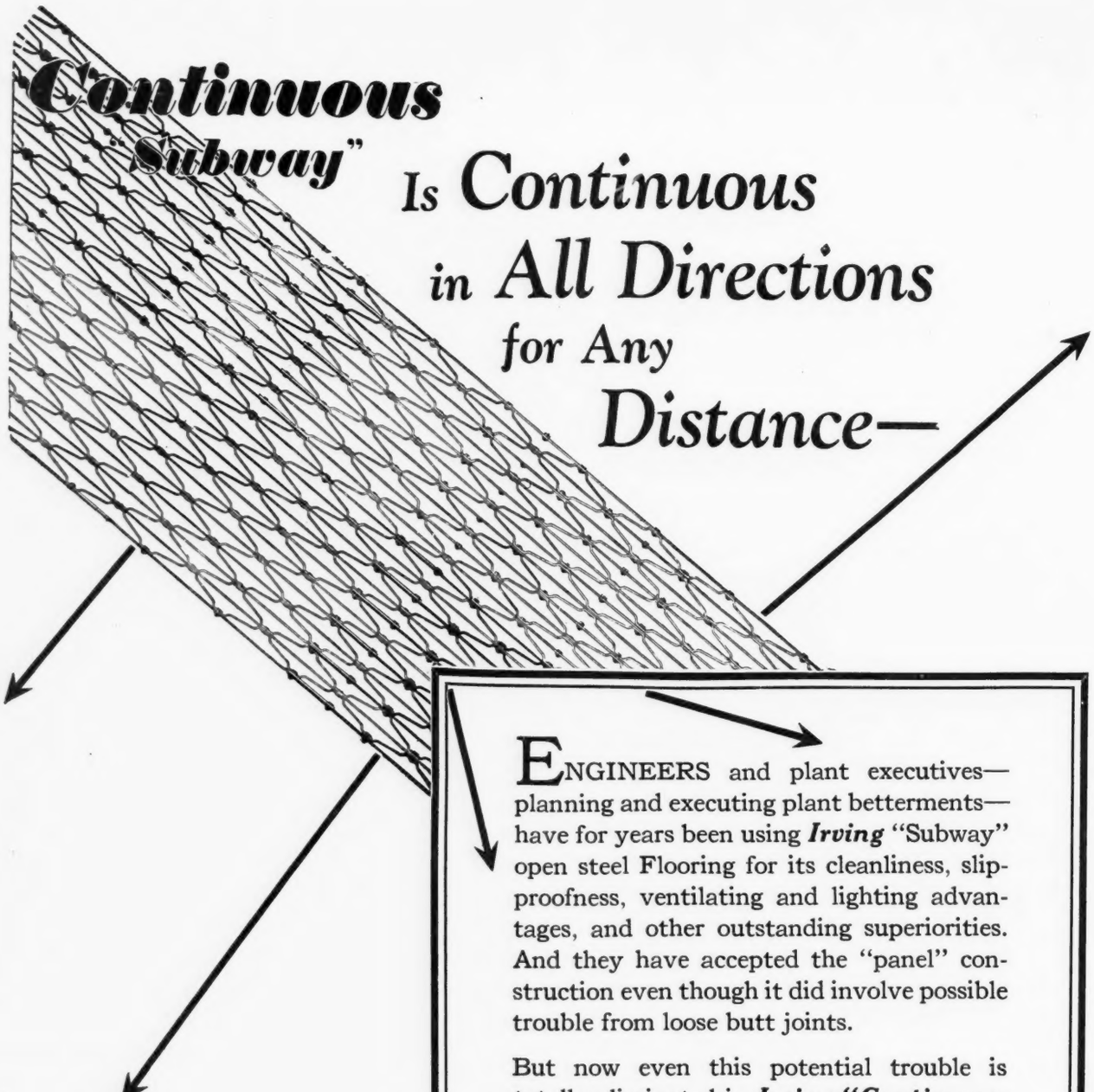

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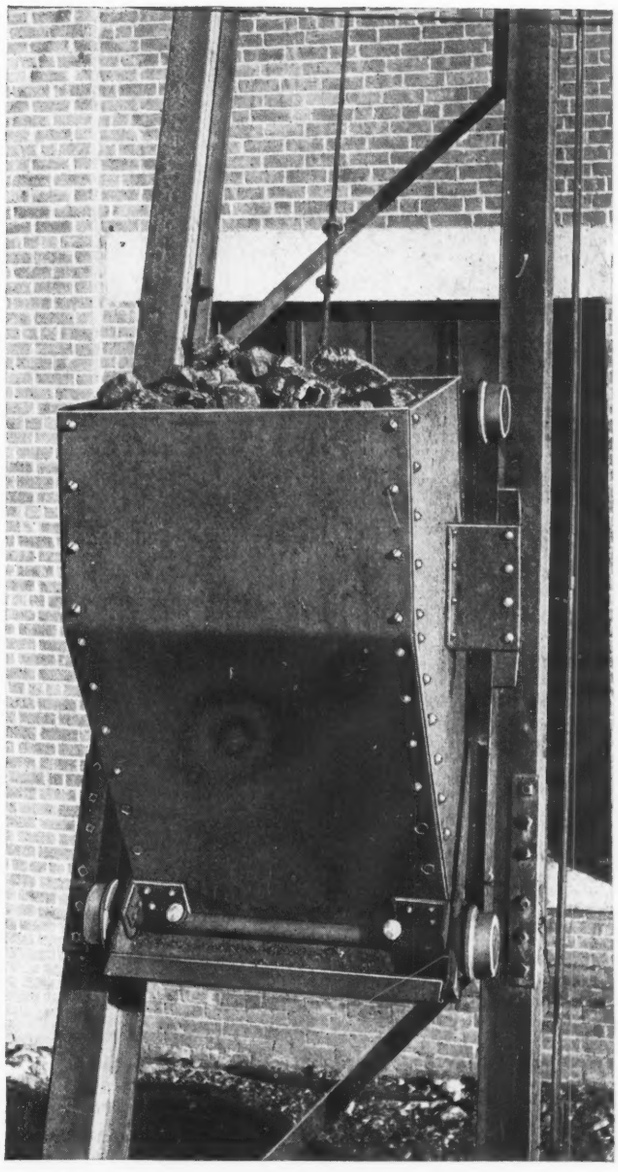
Under certain conditions skip hoists have advantages that give them the first call regardless of the amount of room available.

For instance, suppose that some extra large lumped coal or particularly corrosive ashes have to be raised several stories, say a hundred feet. Elevator buckets would not be practical and a conveyor, if practical, might not be economical.

Elevating by skip hoists is sound practice where conditions warrant but intelligent analysis of conditions is the first step. Robins engineers are well-experienced in such work.



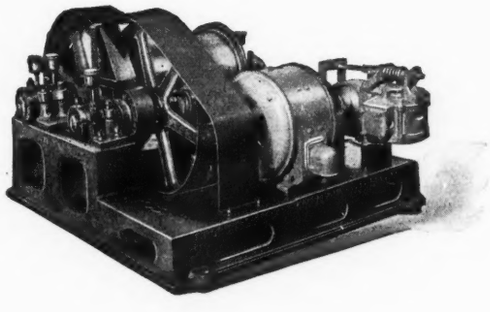
ROBINS CONVEYING BELT CO.

NEW YORK **CHICAGO**

Boston Philadelphia Pittsburgh Los Angeles
Johannesburg, South Africa London, England

REPRESENTATIVES:

Birmingham	C. B. Davis Engineering Co.
Cardin, Okla	Ore Reclamation Co.
El Paso	Ammex Equipment Co.
New Orleans	A. M. Lockett & Co., Ltd.
San Francisco	Joshua Hendy Iron Works
Salt Lake City	The National Equipment Co.
Seattle	B. F. Easterbrooks Co.



Robins makes a complete line of skip hoists. The type needed for specific conditions is available.

Also, Robins builds skip hoist engines for light duty-high speed or heavy duty-low speed work. If desired, these engines will be incorporated in existing skip hoist layouts.

Conveying and Elevating Equipment
Sizing and Screening Equipment
Stocking and Reclaiming Systems

MATERIAL HANDLING
ROBINS
EQUIPMENT

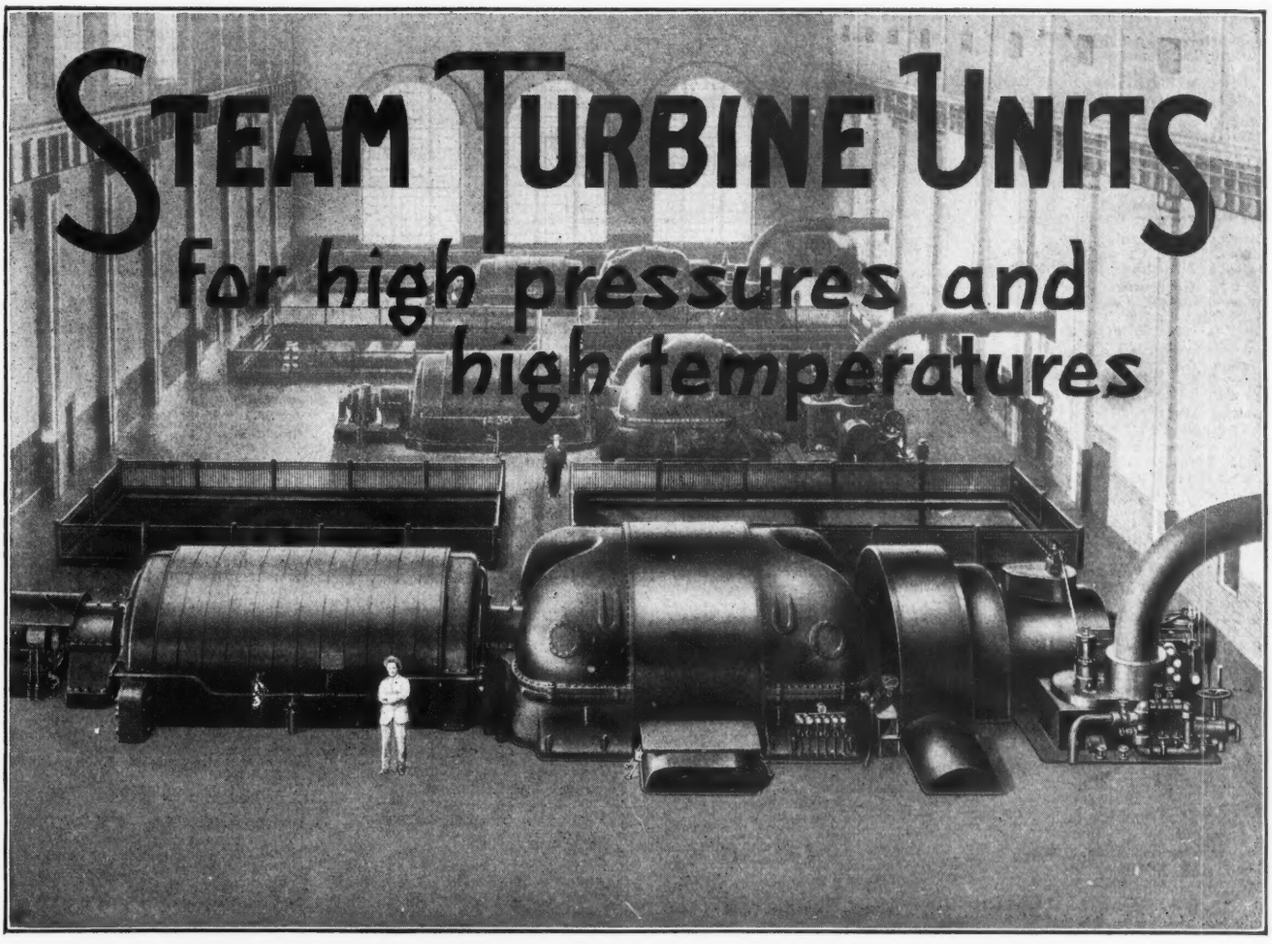
WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used in the Power Plant Field with Names and Addresses of Manufacturers and Distributors Whose Advertisements Appear in This Issue

See Last Page for Alphabetical Index

This index is published as a convenience to the reader. Every care is taken to make it accurate, but POWER assumes no responsibility for errors or omissions.

Accumulators, Steam
Ruth Steam Storage Co., N. Y.
Acetylenes, Dissolved
Union Carbide & Carbon Co., N. Y.
Aftercoolers and Receivers, Air
Alberger Heater Co., Buffalo
Foster-Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Ingersoll-Rand Co., N. Y.
Pennsylvania Pump & Compressor Co., Easton
Air Chambers
Hercules Float Wks., Springfield.
Air Washers
Sturtevant Co., B. F., Hyde Park
Alternators, Turbo
Electric Machinery Mfg. Co., Minneapolis
Elliott Co., Jeannette, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh
Arches, Boiler Door
McLeod & Henry Co., Troy, N. Y.
Arches, Flat, Suspended
Bernitz Furnace Appliance Co., Boston
Bigelow-Liptak Corp., Detroit
McLeod & Henry Co., Troy, N. Y.
Asbestos Products
Carey Co., Philip, Lockland
Ash Gates and Hoppers for Pulverized Fuel
Allen, Sherman, Hoff Co., Phila
Beaumont Mfg. Co., Philadelphia
Ash Handling Equipment
Allen, Sherman, Hoff Co., Phila.
Beaumont Mfg. Co., Philadelphia
Combustion Engineering Corp., N.Y.
Detrick Co., M. H., Chicago
Gruendler Patent Crusher & Pulverizer Co., St. Louis
International Combustion Engrg. Corp., N. Y.
Link-Belt Co., Chicago
Portable Machinery Co., Clifton, N.J.
Robins Conveyor Belt Co., N. Y.
United Conveyor Corp., Chicago
Ash Quenchers
Allen, Sherman, Hoff Co., Phila.
Beaumont Mfg. Co., Philadelphia
Ash Sluicing Systems
Allen, Sherman, Hoff Co., Phila.
Ash Systems, Pneu. Conveyor
United Conveyor Corp., Chicago
Ash Tank Tile
United Conveyor Corp., Chicago
Baffle Contractors, Boiler
Boiler Engineering Co., Newark
Baffle Walls, Boiler
Bigelow-Liptak Corp. Detroit
Boiler Engineering Co., Newark
Carborundum Co., Perth Amboy
King Refractories Co., Buffalo
McLeod & Henry Co., Troy, N. Y.
Page Contracting Co., Inc., Fred'k, N. Y.
Baffles, Monolithic
Boiler Engineering Co., Newark
King Refractories Co., Buffalo
Quigley Furnace Specialties Co., N. Y.
Baffles Walls, Monolithic
Boiler Engineering Co., Newark
Bearings
Dodge Mfg. Corp., Mishawaka
Belting
Dayton Rubber Mfg. Co., Dayton
Goodrich Rubber Co., The B. F., Akron
Greene, Tweed & Co., N. Y.
Quaker City Rubber Co., Wissinoming
Belting, Conveyor
Goodrich Rubber Co., The B. F., Akron
Robins Conveyor Belt Co., N. Y.
Belting, Rubber
Quaker City Rubber Co., Wissinoming
Bins, Coal and Ash
Beaumont Mfg. Co., Philadelphia
Industrial-Brownhoist Corp., Cleveland
Blowers, Centrifugal
Bayley Blower Co., Milwaukee
De Laval Steam Turbine Co., Trenton
Elliott Co., Jeannette, Pa.
Sturtevant Co., B. F., Hyde Park
Wing Mfg. Co., L. J., N. Y.
Blowers, Fan
Bayley Blower Co., Milwaukee
Buffalo (N. Y.) Forge Co.
Clarage Fan Co., Kalamazoo, Mich
Sturtevant Co., B. F., Hyde Park
Wing Mfg. Co., L. J., N. Y.
Blowers, Forced & Induced Draft
Air Preheater Co., N. Y.
Bayley Blower Co., Milwaukee
Buffalo (N. Y.) Forge Co.
Clarage Fan Co., Kalamazoo, Mich
Coppus Engineering Corp., Worcester
McClave-Brooks Co., Scranton, Pa.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park
Wing Mfg. Co., L. J., N. Y.
Blowers, Soot for Boiler Tubes
Bayer Co., St. Louis
Diamond Power Specialty Corp., Detroit
Enterprise Machine Co., Middletown, Ohio
Vulcan Soot Cleaner Co., Du Bois
Blowers, Steam Jet
Chesterton Co., A. W., Boston
McClave-Brooks Co., Scranton, Pa.
Blowers, Turbine
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co., N. Y.
Moore Steam Turbine Corp., Wellsville, N. Y.
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford
Wing Mfg. Co., L. J., N. Y.
Boiler Blow Down Equipment
Henszey DeConcentrator Co., Watertown.
Boiler, Blow Down System Continuous
Elgin Softener Corp., Elgin
Henszey DeConcentrator Co., Watertown.
Boiler Compound
Dearborn Chemical Co., Chicago
Garratt-Callahan Co., Chicago
Boiler, Concentration Control Equipment
Henszey DeConcentrator Co., Watertown.
Boiler Fronts
McClave-Brooks Co., Scranton, Pa.
Boiler Insulation
Carey Co., Philip, Lockland
General Insulating Mfg. Co., Alexandria, Ind.
Boiler Setting
Bernitz Furnace Appliance Co., Boston
Bigelow-Liptak Corp., Detroit
Carborundum Co., Perth Amboy
Cement Gun Co., Allentown
Custodis Chimney Constr. Co., Alphons, New York
Detrick Co., M. H., Chicago
Keystone Refractories Co., New York
Laclede-Christy, St. Louis
Lavino & Co., E. J., Philadelphia
North American Refractories Co., Cleveland
Obermayer Co., S., Chicago
Page Contracting Co., Inc., Fred'k, N. Y.
Rust Engineering Co., Pittsburgh
Boiler Tube Cleaners
(See Blowers, Soot, and Boiler)
(See Scale Removers)
(See Tube Cleaners Boiler)
Boilers, Heating
Babcock & Wilcox Co., N. Y.
Edge Moor (Del.) Iron Co.
Boilers, Locomotive
Connelly Boiler Co., D., Cleveland
Boilers, Return Tubular
Connelly Boiler Co., D., Cleveland
Union Iron Works, Erie, Pa.
Vogt Mach. Co., Henry, Louisville
Boilers, Waste Heat
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N.Y.
Edge Moor (Del.) Iron Co.
Heine Boiler Co., N. Y.
International Combustion Eng. Corp., N. Y.
Ladd Water Tube Boiler Co., N. Y.
Wickes Boiler Co., Saginaw
Boilers, Water Tube, Cross Drum, Horizontal, Inclined, Vertical
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N.Y.
Connelly Boiler Co., D., Cleveland
Edge Moor (Del.) Iron Co.
International Combustion Eng. Corp., N. Y.
Kingsford Fdy. & Mach. Co., Oswego, N. Y.
Ladd Water Tube Boiler Co., N. Y.
Springfield (Ill.) Boiler Co.
Union Iron Works, Erie, Pa.
Vogt Machine Co., Henry, Louisville
Wickes Boiler Co., Saginaw, Mich
Breechings
Griscom-Russell Co., N. Y.
Heine Boiler Co., N. Y.
Brick, Fire
Babcock & Wilcox Co., N. Y.
Bernitz Furnace Appliance Co., Boston
Carborundum Co., Perth Amboy
Evens & Howard Fire Brick Co., St. Louis
General Refractories Co., Phila.
Harbison-Walker Refractories Co., Pittsburgh
Laclede-Christy, St. Louis
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y.
North American Refractories Co., Cleveland
Obermayer Co., S., Chicago
Brick, Fire, Cement and Mortar
Babcock & Wilcox Co., N. Y.
Brick, Fire, Plastic
Babcock & Wilcox Co., N. Y.
Brushes, Motor & Generator
Dixon Crucible Co., Jos., Jersey City
Bucket Carriers, Pivoted
Link-Belt Co., Chicago
Buckets, Clam Shell
Industrial-Brownhoist Corp., Cleveland
Buckets, Elevator
Dodge Mfg. Corp., Mishawaka
Hendrick Mfg. Co., Carbondale
Link-Belt Co., Chicago
Robins Conveyor Belt Co., N. Y.
Bunkers, Coal
Allen, Sherman, Hoff Co., Phila.
Beaumont Mfg. Co., Philadelphia
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago
Burners, Fuel Oil
Peabody Engineering Corp., N. Y.
Burners, Gas
Gas Combustion Co., Pittsburgh
Peabody Engr. Corp., N. Y.
Burners, Oil
Babcock & Wilcox Co., N. Y.
Bethlehem (Pa.) Steel Co.
Coen Co., San Francisco
Combustion Eng. Corp., N. Y.
Hammel Oil Burning Equqipt. Co., Providence
International Combustion Engrg. Corp., N. Y.
Peabody Engineering Corp., N. Y.
Schutte & Koerting Co., Philadelphia
Woolley & Co., E. L., Providence
Burners, Powdered Coal
Fuller-Lehigh Co., Fullerton, Pa.
Peabody Engineering Corp., N. Y.
Castings, Chilled Iron
Fuller-Lehigh Co., Fullerton
Castings, Grey Iron
Fuller Lehigh, Fullerton
Riley Stoker Corp., Worcester
Cement, Asbestos
Carey Co., Philip, Lockland
Cement, Fire Brick
Babcock & Wilcox Co., N. Y.
General Refractories Co., Phila
Keystone Refractories Co., New York
King Refractories Co., Buffalo
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S., Chicago
Quigley Furnace Specialties Co., N. Y.
Cement, High Temperature
Babcock & Wilcox Co., N. Y.
King Refractories Co., Buffalo
Lavino & Co., E. J., Philadelphia
Quigley Furnace Specialties Co., N. Y.
Cement, Iron
Obermayer Co., S., Chicago
Smooth-On Mfg. Co., Jersey City
Cement, Pipe Joint
Dixon Crucible Co., Jos., Jersey City
Smooth-On Mfg. Co., Jersey City
Cement Placing Machines
Cement Gun Co., Allentown
Central Station Construction
Stone & Webster, Inc., Boston
Chain Drive
Link-Belt Co., Chicago
Philadelphia (Pa.) Gear Works
Chemicals, Water Testing
National Aluminate Co., Chicago
Chimneys (See Stacks)
Clamps, Pipe
Smooth-On Mfg. Co., Jersey City
Yarnall-Waring Co., Phila.
Clutches, Friction
Dodge Mfg. Corp., Mishawaka
Link-Belt Co., Chicago
Coal Bunker Lining
Wailes, Dove & Hermiston Corp., N. Y.
Coal Crushers
American Pulverizer Co., St. Louis
Combustion Engineering Corp., N.Y.
Fuller Lehigh Co., Fullerton, Pa.
Gruendler Patent Crusher & Pulverizer Co., St. Louis
International Combustion Eng. Corp., N. Y.
Link-Belt Co., Chicago
Robins Conveyor Belt Co., N. Y.
Strong-Scott Mfg. Co., Minneapolis
Coal Feeders, Travelling & Stationary
Robins Conveyor Belt Co., N. Y.
Coal Handling Equipment
Beaumont Mfg. Co., Philadelphia
Gruendler Patent Crusher & Pulverizer Co., St. Louis
Hunt Co., C. W., West New Brighton, N. Y.
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago
Portable Machinery Co., Clifton, N.J.
Robins Conveyor Belt Co., N. Y.
Coating, Protective
Quigley Furnace Specialties Co., N. Y.
Cocks, Brass and Iron Body
Homestead Valve Mfg. Co., Coraopolis
Cocks, Gage
Nason Mfg. Co., N. Y.
Cocks, Steam
Dart Mfg. Co., E. M., Providence
Homestead Valve Mfg. Co., Coraopolis
Combustion Chamber, Back Arch
Detrick Co., M. H., Chicago
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S., Chicago
Combustion Control Systems
Hagan Corp., Pittsburgh
Smoot Engr. Corp., N. Y.
Commutator Compound
Dixon Crucible Co., Jos., Jersey City
CO_2 Recorders and Flue Gas Analysis Instruments
Brown Instrument Co., Phila.
Leeds & Northrup Co., Phila.
Permutit Co., N. Y.
Republic Flow Meters Co., Chicago
Compressors, Air
Allis-Chalmers Mfg. Co., Milwaukee
Ingersoll-Rand Co., N. Y.
Nash Engineering Co., So. Norwalk
Pennsylvania Pump & Compressor Co., Easton
Sullivan Machinery Co., Chicago
Worthington Pump & Machinery Corp., N. Y.
Compressors, Ammonia
Ingersoll-Rand Co. N. Y.
Compressors, Gasoline
Sullivan Machinery Co., Chicago
Compressors, Extraction
Sullivan Mchy. Co., Chicago
Compressors, Thermo
Foster-Wheeler Corp., N. Y.
Condensers, Ammonia
Acme Welded Pipe & Coil Co., Jackson
Condensers, Barometric, Combined, Jet, Surface
Alberger Heater Co., Buffalo
Allis-Chalmers Mfg. Co., Milwaukee
Bethlehem (Pa.) Steel Co.
Buffalo (N. Y.) Steam Pump Co.
Elliott Co., Jeannette, Pa
Foster Wheeler Corp., N. Y.
Ingersoll-Rand Co., N. Y.
Schutte-Koerting Co., Phila.
Westinghouse Electric & Mfg. Co., East Pittsburgh
Wheeler Mfg. Co., C. H., Phila.
Worthington Pump & Machinery Corp., N. Y.
Condensers, Coil
Acme Welded Pipe & Coil Co., Jackson
Superheater Co., N. Y.
Conduits, Underground
American District Steam Co., No. Tonawanda
Consulting Engineers
Stone & Webster, Inc., Boston
Controllers, Electric
Westinghouse Electric & Mfg. Co., East Pittsburgh
Controllers, Flow, Liquid Level, Speed Temperature
Brown Instrument Co., Phila.



THE trend in modern power plant practice involving high pressures and high temperatures, presents new problems in steam turbine design. Allis-Chalmers engineers have pioneered in research in high pressures and high temperatures in their effect on materials. Notable installations involving steam pressures up to 600 lbs. and temperatures up to 725° F., including units of large capacities such as the 50,000 k.w. unit shown above, are evidence of Allis-Chalmers engineering progress. Larger units for these operating conditions are under construction.

Allis-Chalmers is prepared to build turbines for high pressures and temperatures, limited only by the suitability of present available materials. This organization builds turbo-generator units for industrial and auxiliary service as well as high efficiency units for central station operation, which include straight condensing, non-condensing, condensing or non-condensing bleeder, and condensing mixed pressure types.

Allis-Chalmers engineering experience is at your service in steam turbine and condenser problems of power plant design.

ALLIS-CHALMERS

MILWAUKEE, WIS. U.S.A.

Converters, Rotary
Elliott Co., Jeannette, Pa.

Converters, Synchronous
Elliott Co., Jeanette, Pa.

Conveying Machinery
Dodge Mfg. Corp., Miskawaka

Conveyors, Belt
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago
Robins Conveyor Belt Co., N. Y.

Conveyors, Pneumatic
United Conveyor Corp., Chicago

Conveyors, Portable
Link-Belt Co., Chicago
Portable Machinery Co., Clifton, N.J.

Coolers, Generator
Griscom-Russell Co., N. Y.
Sturtevant Co., B. F., Hyde Park
Westinghouse Electric & Mfg. Co., East Pittsburgh

Coolers, Oil
Griscom-Russell Co., N. Y.
Schutte & Koerting Co., Philadelphia

Coolers, Water
Vogt Mach. Co., Henry, Louisville

Cooling Plants and Ponds
Binks Spray Equipment Co., Chicago
Marley Co., Kansas City, Mo.
Yarnall-Waring Co., Phila.

Cooling Towers
Foster Wheeler Corp., N. Y.
Marley Co., Kansas City
Seymours, Inc., Jas. M., East Orange
Wheeler Mfg. Co., C. H., Phila.

Couplings, Flexible Shaft, Rigid, Shaft
De Laval Steam Turbine Co., Trenton, N. J.
Nicholson & Co., W. H., Wilkes-Barre
Philadelphia (Pa.) Gear Works
Terry Steam Turbine Co., Hartford

Covering, Pipe & Boiler
Carey Co., Philip, Lockland
General Insulating Mfg. Co., Alexandria, Ind.
Lavino & Co., E. J., Philadelphia
Obermayer Co., S., Chicago

Cranes
Industrial-Brownhoist Corp., Cleveland

Cranes, Creeper, Type, Locomotive, Gas and Steam
American Hoist & Derrick Co., St. Paul
Industrial-Brownhoist Corp., Cleveland
Link Belt Co., Chicago

Credit Service
Commercial Credit Co., Baltimore

Cutters, Boiler Tubes
(See Pipe Cutters)

Dampers
Clarage Fan Co., Kalamazoo, Mich.

Deaerators
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.

Dealers Machinery
(See Searchlight Section)
Consolidated Products Co., Inc.
Crawbuck, J. B.
Greenspons Iron & Steel Co.
Fuerst Friedman Co., The
Hunt's Sons, M. J.
Industrial Plants Corp.
Johnson, Handley & Johnson Co.
Land, L. J.
Nashville Industrial Corp.
O'Brien Mchy. Co.
Phoenix Utilities Co.
Power Plant Equipment Co.
Randle Mchy. Co.
Reading Engine Works
Sachsenmaier, Geo.

Debydrators
Acme Welder Pipe & Coil Co., Jackson

Desuperheaters
Elliott Co., Jeanette, Pa.
Schutte & Koerting Co., Philadelphia
Superheater Co., New York

Die Stocks
Curtis & Curtis Co., Bridgeport
Toledo (Ohio) Pipe Threading Mach. Co.

Distilling Apparatus (Water)
Bethlehem (Pa.) Steel Co.
Griscom-Russell Co., N. Y.

Doors, Furnace Inspection
Springfield (Ill.) Boiler Co.

Draft, Mechanical
(See Blowers, Fan)

Drainers, Low Pressure
Cochrane Corp., Phila.

Dressing, Belt
Dixon Crucible Co., Jos., Jersey City
Texas Co., New York

Drop Forgings
Ingersoll-Rand Co., N. Y.
Vogt Mach. Co., Henry, Louisville

Duct Insulation
General Insulating Mfg. Co. Alexandria, Ind.

Dust Collectors
Sturtevant Co., B. F., Hyde Park

Dust Removers
Sturtevant Co., B. F., Hyde Park

Dynamometers
Leeds & Northrup Co., Phila.
Wheeler Mfg. Co., C. H., Phila.

Dynamos (See Generators)

Economizers
Babcock & Wilcox Co., N. Y.
Foster Wheeler Corp., N. Y.
Green Fuel Economizer Co., Beacon, N. Y.
Sturtevant Co., B. F., Hyde Park

Ejectors
Bethlehem (Pa.) Steel Co.
Chaplin-Fulton Mfg. Co., Pittsburgh
Nash Engineering Co., So. Norwalk
Penberthy Injector Co., Detroit

Ejectors, Air
Westinghouse Electric & Mfg. Co., East Pittsburgh
Wheeler Mfg. Co., C. H., Phila.

Ejectors, Sewage
Nash Engineering Co., So. Norwalk

Ejectors, Water
Chaplin Fulton Mfg. Co., Pittsburgh
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Elliott Co., Jeannette, Pa.

Electric Generating Sets, Steam Turbine
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford

Elevators and Conveyors
Industrial-Brownhoist Corp., Cleveland
Link & Belt Co., Chicago

Enamel
Wailes, Dove & Hermiston Corp., New York

Engine Generators
Elliott Co., Jeannette, Pa.

Engineering Service
Stone & Webster, Inc., Boston

Engines, Corliss
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeannette, Pa.

Engines, Diesel
Bethlehem (Pa.) Steel Co.
Buda Co., Harvey
Worthington Pump & Machinery Corp., N. Y.

Engines, Gas and Oil
Allis-Chalmers Mfg. Co., Milwaukee
Buda Co., Harvey
Ingersoll-Rand Co., N. Y.
Sterling Engine Co., Buffalo
Worthington Pump & Machinery Corp., N. Y.

Engines, Poppet-Valve
Elliott Co., Jeanette, Pa.

Engines, Steam
Air Preheater Corp., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee
Clarage Fan Co., Kalamazoo, Mich.
Elliott Co., Jeanette, Pa.
Skinner Engine Co., Erie
Sturtevant Co., B. F., Hyde Park
Troy (Pa.) Engine & Machine Co.

Engines, Unaflow
Elliott Co., Jeanette, Pa.
Skinner Engine Co., Erie

Evaporators
Bethlehem (Pa.) Steel Co.
Foster Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.

Exhaust Heads
Burt Mfg. Co., Akron
Hoppes Mfg. Co., Springfield, O.
Sturtevant Co., B. F., Hyde Park
Swartwout Co., Cleveland
Wright Austin Co., Detroit

Exhausters, Gas
Sturtevant Co., B. F., Hyde Park

Expansion Joints
American District Steam Co., No. Tonawanda
Carey Co., Philip, Lockland
Foster Wheeler Corp., N. Y.
Grinnell Co., Providence
Griscom-Russell Co., N. Y.
Howard Iron Works, Buffalo
Wheeler Mfg. Co., C. H., Phila.

Extractors, Oil & Grease
Elliott Co., Jeanette, Pa.

Fans, Exhaust and Ventilator
(See Blowers, Fan)

Fans, Forced & Induced Draft
Coppus Engineering Corp., Worcester
Green Fuel Economizer Co., Beacon
Sturtevant Co., B. F., Hyde Park

Feeders, Pulverized Coal
Fuller-Lehigh Co., Fullerton

Filters, Feed Water, Pressure—Water
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Permutit Co., New York

Filters, Oil
Burt Mfg. Co., Akron
Elliott Co., Jeannette, Pa.

Filters, Oil Removal
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Permutit Co., New York

Filters, Oil System
Burt Mfg. Co., Akron

Financing Service
Commercial Credit Co., Baltimore

Firebox Blocks
Bernitz Furnace Appliance Co., Boston
Carborundum Co., Perth Amboy

Fittings, Ammonia
Greene, Tweed & Co., N. Y.
Vogt Machine Co., Henry, Louisville

Fittings, Steel
Crane Co., Chicago
Limbert & Co., Geo. B., Chicago
Pittsburgh (Pa.) Pipe & Equip. Co.

Flanges
Dart Mfg. Co., E. M., Providence
Grinnell Co., Providence
Limbert & Co., Geo. B., Chicago
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh
Vogt Machine Co., Henry, Louisville

Floats
Hercules Float Wks., Springfiled

Floor, Armoring
Hendrick Mfg. Co., Carbondale
Irving Iron Works Co., Long Island City

Flooring, Fireproof
Dravo Doyle Co., Pittsburgh
The Tri Lox Co., Pittsburgh

Flooring, Non-slipping
Dravo Doyle Co., Pittsburgh
The Tri Lox Co., Pittsburgh

Flooring, Open Steel
Dravo Doyle Co., Pittsburgh
Hendrick Mfg. Co., Carbondale
Irving Iron Works Co., Long Island City
The Tri Lox Co., Pittsburgh

Flooring, Steel
Dravo Doyle Co., Pittsburgh
The Tri Lox Co., Pittsburgh

Flooring, Ventilating
Dravo Doyle Co., Pittsburgh
The Tri Lox Co., Pittsburgh

Fuel Oil Systems
Bethlehem (Pa.) Steel Co.
Coen Co., San Francisco
Combustion Engineering Corp., N. Y.
Hammel Oil Burning Equipt. Co. Providence
International Combustion Engr. Corp., N. Y.
Peabody Engineering Corp., N. Y.

Furnace Arches
Bigelow-Liptak Corp., Detroit
Carborundum Co., Perth Amboy
Detrick Co., M. H., Chicago
DeWolf Furnace Corp., Rochester
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S., Chicago

Furnace Bottoms, Cast Iron Air Cooled
Allen, Sherman, Hoff Co., Phila.
Beaumont Mfg. Co., Philadelphia

Furnace Construction
Bigelow-Liptak Corp., Detroit
Cement Gun Co., Allentown
Lavino & Co., E. J. Philadelphia
Stratton Engineering Corp., N. Y.

Furnace Linings
American Engineering Co., Phila.
Babcock & Wilcox Co., N. Y.
Bernitz Furnace Appliance Co., Boston
Bigelow-Liptak Corp., Detroit
Carborundum Co., Pert Amboy
Cement Gun Co., Allentown
General Refractories Co., Phila.
Harbison-Walker Refractories Co., Pittsburgh
Keystone Refractories Co., N. Y.
Laclede-Christy, St. Louis
Lavino & Co., E. J, Philadelphia
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S., Chicago

Furnace Walls, Water Cooled
American Engineering Co., Phila.
Combustion Eng. Corp., N. Y.
Edge Moor (Del.) Iron Co.
Foster Wheeler Corp., N. Y.
International Combustion Eng. Corp., N. Y.
Springfield (Ill.) Boiler Co.
Superheater Co., N. Y.

Furnaces
American Engineering Co., Phila.
Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
DeWolf Furnace Corp., Rochester
Fuller Lehigh Co., Fullerton, Pa.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa
Stratton Engineering Corp., N. Y.

Furnaces, Bagasse & Wood Burning
Bigelow-Liptak Corp., Detroit
Combustion Engineering Corp., N. Y.
Detrick Co., M. H., Chicago
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Furnaces, Incinerator
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Gage Glass Guards and Shields
Wright Austin Co., Detroit

Gage Glasses
Chesterton Co., A. W., Boston
Jenkins Bros. N. Y.

Gages, Boiler Water Level, Distant Reading
Brown Instrument Co., Phila.

Gages, Differential, Draft, Liquid Depth, Pressure, Recording Vacuum, Water
American Schaeffer Budenberg Div. Consolidated Ashcroft Hancock Corp., N. Y.
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Brown Instrument Co., Phila.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Greene, Tweed & Co., N. Y.
Penberthy Injector Co., Detroit
Republic Flow Meters Co., Chicago
Yarnall-Waring Co., Philadelphia

Gas Burning Equipment
Coen Co., San Francisco
Peabody Engineering Corp., N. Y.

Gas, Welding
Union Carbide & Carbon Co., N. Y.

Gaskets
Advance Packing & Supply Co., Chicago
Flexitallic Gasket Co., Camden, N. J.
Greene, Tweed & Co., N. Y.
Metallo Gasket Co., New Brunswick
Quaker City Rubber Co., Wissinoming
Smooth-On Mfg. Co., Jersey City, N.J.

Gates, Air Blast
McClave-Brooks Co., Scranton.

Gates, Coal & Ash Bin
Allen, Sherman, Hoff Co., Phila.
Beaumont Mfg. Co., Philadelphia
Hunt Co., C. W., West New Brighton, N. Y.
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Gears
Link-Belt Co., Chicago
Philadelphia (Pa.) Gear Works
Westinghouse Electric & Mfg. Co., East Pittsburgh

Gears, Double Helical
De Laval Steam Turbine Co., Trenton, N. J.

Gears, Reduction
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Philadelphia (Pa.) Gear Works
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford
Westinghouse Electric & Mfg. Co., East Pittsburgh

Generating Sets
Elliott Co., Jeanette, Pa.
Sturtevant Co., B. F., Hyde Park

Generators, Electric
Elliott Co., Jeanette
Lincoln Electric Co., Cleveland
Sturtevant Co., B. F., Hyde Park
Westinghouse Electric & Mfg. Co., East Pittsburgh

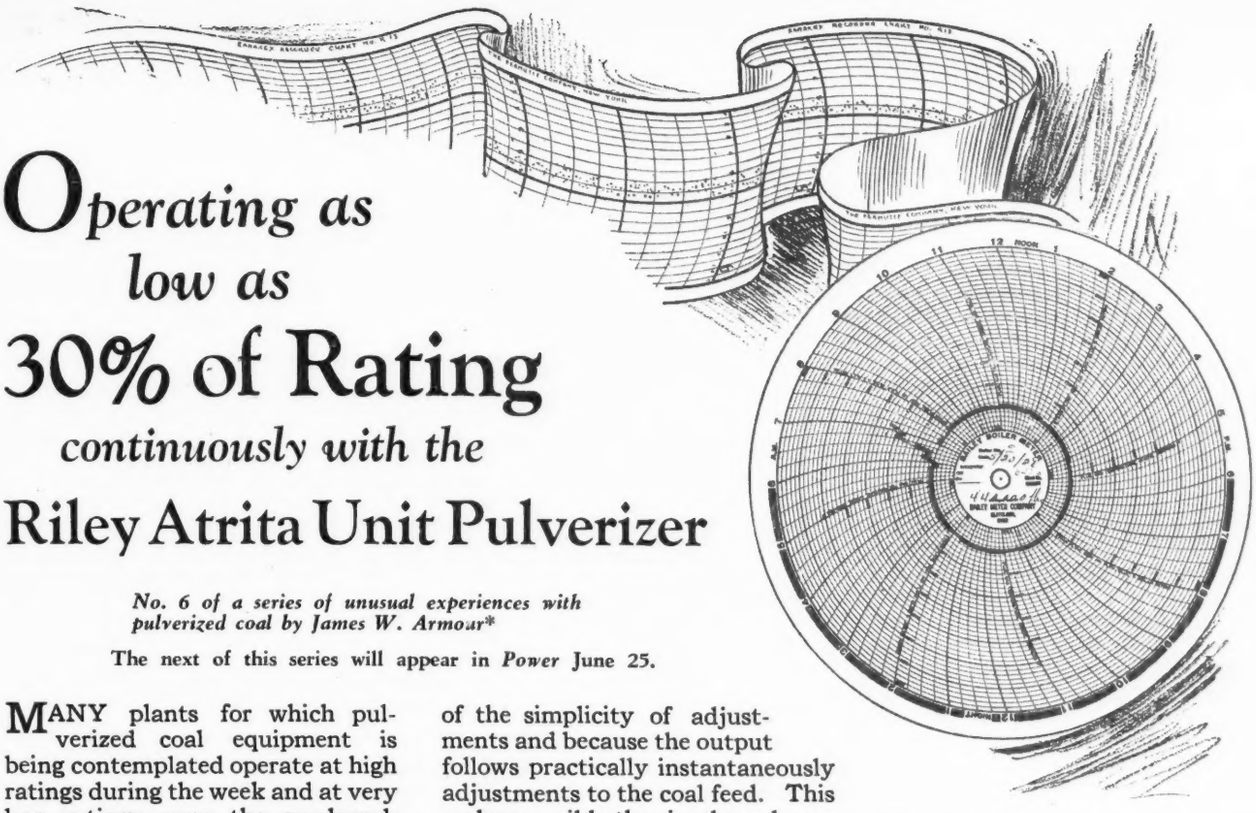
Governors, Pressure
Northern Equipment Co., Erie

Governors, Pump
Atlas Valve Co., Newark
Chaplin-Fulton Mfg. Co., Pittsburgh
Davis Regulator Co., G. M., Chicago
Northern Equipment Co., Erie
Strong, Carlisle & Hammond Co., Cleveland
Swartwout Co., Cleveland
Watts Regulator Co., Lawrence, Mass.

Graphite
Dixon Crucible Co., Jos., Jersey City
Greene, Tweed & Co., N. Y.
United States Graphite Co., Saginaw

Grates, Dumping
Babcock & Wilcox Co., N. Y
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering Corp., N. Y.
Kelly Foundry & Machine Co., Goshen
McClave-Brooks Co., Scranton, Pa
Neemes Fdry., Inc., Troy
Riley Stoker Corp., Worcester
Vogt Mach. Co., Henry, Louisville

Grates, Shaking
Babcock & Wilcox Co., N. Y.
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering, Corp., N. Y.
Kelly Foundry & Machine Co., Goshen
McClave-Brooks Co., Scranton, Pa.
Neemes Fdry., Inc., Troy
Riley Stoker Corp., Worcester
Vogt Mach. Co., Henry, Louisville



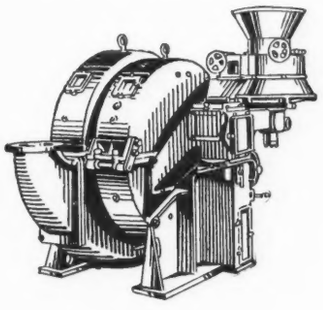
Operating as low as 30% of Rating *continuously with the* Riley Atrita Unit Pulverizer

*No. 6 of a series of unusual experiences with pulverized coal by James W. Armour**

The next of this series will appear in *Power* June 25.

MANY plants for which pulverized coal equipment is being contemplated operate at high ratings during the week and at very low ratings over the week-end. Other plants carry high loads during the day and light loads at night. It is apparent that if pulverized fuel is to be satisfactory in these plants, the equipment must have characteristics which will make it possible to carry such varying loads. The above illustration is a CO_2 and flow meter chart taken from the Aberfoyle Manufacturing Co. where Riley Atrita Unit Pulverizers are being used for just such service. Here the operation during the week approaches at times 300% of boiler rating. During Sunday, when this chart was taken, the load decreases to as low as 30% of rating. Yet, as seen from the CO_2 chart, operation at this very low rating is very satisfactory.

This low rating is obtained with continuous operation of the pulverizer and burner and without the necessity of making difficult adjustments. Riley Atrita Unit Pulverizers and burners can meet the most extreme fluctuations because of the simplicity of adjustments and because the output follows practically instantaneously adjustments to the coal feed. This makes possible the simple and easy hook-up of this system to complete automatic control. Extreme fluctuations and unusually high and low loads mean nothing to the Riley Atrita Unit Pulverizer and burner. It is just second nature to them. This system not only meets these conditions but it meets them with high economy. Plant after plant is establishing high efficiency records with this pulverizer.



Riley Atrita
Unit Pulverizer

Monthly efficiencies well over 85% have become the rule.

But high combustion efficiency is not all. You do not have the bang and clatter that you have learned to associate with pulverizers, when Riley Atrita Unit Pulverizers are used. Just a pleasing purr assuring you that all is well inside the machine. Power consumption is low. High moisture coals can be handled without the use of dryers. Maintenance has been reduced in the past two years to such a point that pulverizing elements need scarcely ever be replaced oftener than every five months and many times they will last for ten months. No need to worry about maintenance like this. I know of no pulverizer which will give such high efficiency as well as such all around satisfaction.

The Riley Stoker Corporation, 9 Neponset Street, Worcester, Mass., will gladly send you a copy of a 28-page catalog describing this unusual pulverizer. Ask for Catalog DM-105-296.

*Vice-President and Engineering Manager, Riley Stoker Corporation, Worcester, Mass.

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McClave-Brooks Co., Scranton, Pa.
Neemes Fdry., Inc., Troy
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Hendrick Mfg. Co., Carbondale
Irving Iron Works Co., Long Island City

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Texas Co., N. Y.

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Cement Gun Co., Allentown

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Midwest Piping & Supply Co., St. Louis

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Superheater Co., N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh
Wheeler Mfg. Co., C. H., Phila.

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Air Preheater Co., N. Y.
Combustion Engineering Corp., N. Y.
Babcock & Wilcox Co., N. Y.
Foster Wheeler Corp., N. Y.
International Combustion Engr. Corp., N. Y.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

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Foster-Wheeler Corp., N. Y.

Heaters, Deaerating
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Hoppes Mfg. Co., Springfield, O.

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Bethlehem (Pa.) Steel Co.
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Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Hoppes Mfg. Co., Springfield, O.
Neemes Fdry., Troy, N. Y.
Sturtevant Co., B. F., Hyde Park
Swartwout Co., Cleveland
Westinghouse Electric & Mfg. Co., East Pittsburgh
Wheeler Mfg. Co., C. H., Phila.

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Foster-Wheeler Corp., N. Y.
Templeton Steam Trap Co., N. Y.

Heaters, Metering
Cochrane Corp., Phila.

Heaters, Oil
Coen Co., San Francisco
Foster-Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Hammel Oil Burning Equipt. Co. Providence
Wheeler Mfg. Co., C. H.

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Cochrane Corp., Phila.

Heaters, Storage
Cochrane Corp., Phila.

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Sturtevant Co., B. F., Hyde Park

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Clarage Fan Co., Kalamazoo, Mich.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

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Lagonda Mfg. Co., Springfield, Ohio

Hoists, Portable
Sullivan Machinery Co., Chicago

Hoists, Skip
Beaumont Mfg. Co., Philadelphia

Hoists, Steam
Sullivan Machinery Co., Chicago

Hoppers, Coal and Ash
Allen, Sherman, Hoff Co., Phila.
Beaumont Mfg. Co., Philadelphia
Combustion Eng. Corp., N. Y.
International Combustion Engr. Corp., N. Y.
Link-Belt Co., Chicago

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Lagonda Mfg. Co., Springfield, Ohio
Quaker City Rubber Co., Wissinoming

Hydrants
Michigan Valve & Fdy. Co., Detroit

Ice and Refrigerating Machinery (See Refrigerating Machinery)

Idlers, Belt Conveyor
Dodge Mfg. Corp., Mishawaka

Idlers, Conveyor
Dodge Mfg. Corp., Mishawaka
Robins Conveyor Belt Co., N. Y.

Indicators, Combustion
Permutit Co., N. Y.

Indicators, Flow
Morey, Jones & Lovell, Los Angeles

Indicators, Speed
Biddle, James G., Phila.
Scherr Co., Geo., N. Y.
Zernickow Co., O., N. Y.

Indicators, Valve Position
Northern Equipment Co., Erie

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Consolidated Ashcroft Hancock Co., Inc., N. Y.
Penberthy Injector Co., Detroit
Schutte & Koerting Co., Philadelphia

Instruments, Recording
Permutit Co., N. Y.

Insulation Boiler
General Insulating Mfg. Co., Alexandria, Ind.

Insulation, Duct
General Insulating Mfg. Co., Alexandria, Ind.

Insulation, Heat
Carey Co., Philip, Lockland

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Griscom-Russell Co., N. Y.

Lubricants
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United States Graphite Co., Saginaw

Lubricators, Cylinder
Greene, Tweed & Co., N. Y.
Penberthy Injector Co., Detroit

Lubricators, Force Feed
Greene, Tweed & Co., N. Y.

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Brown Instrument Co., Phila.

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Hendrick Mfg. Co., Carbondale

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Bailey Meter Co., Cleveland
Brown Instrument Co., Phila.
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Hoppes Mfg. Co., Springfield, O.
Republic Flow Meters Co., Chicago
Simplex Valve & Meter Co., Phila.
Worthington Pump & Machinery Corp., N. Y.
Yarnall-Waring Co., Phila.

Meters, Coal
Bailey Meter Co., Cleveland
Republic Flow Meters Co., Chicago

Meters, Electric
Westinghouse Electric & Mfg. Co., East Pittsburgh

Meters V-Notch
Bailey Meter Co., Cleveland
Cochrane Corp., Phila.
Hoppes Mfg. Co., Springfield, O.
Yarnall-Waring Co., Phila.

Meters, Volumetric
Cochrane Corp., Phila.
Yarnall-Waring Co., Philadelphia

Meters, Weighing
Cochrane Corp., Phila.

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Elliott Co., Jeanette, Pa.

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Electric Machinery Mfg. Co., Minneapolis
Elliott Co., Jeanette, Pa.
Lincoln Electric Co., Cleveland
Sturtevant Co., B. F., Hyde Park
Westinghouse Electric & Mfg. Co., East Pittsburgh

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Elliott Co., Jeanette, Pa.

Motors, Water
Roto Co., Newark

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Union Carbide & Carbon Co., N. Y.

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Texas Co., N. Y.

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Penberthy Injector Co., Detroit

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Dearborn Chemical Co., Chicago
Texas Co., N. Y.

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Oil, Reclaimers, Centrifugal
De Laval Separator Co.

Oil Reservoirs
Burt Mfg. Co., Akron

Oil Storage Equipment
Bowser & Co., S. F., Fort Wayne, Ind.

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Burt Mfg. Co., Akron

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Brown Instrument Co., Phila.

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Union Carbide & Carbon Co., N. Y.

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Greene, Tweed & Co., N. Y.

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Chesterton Co., A. W., Boston
Greene, Tweed & Co., N. Y.
Quaker City Rubber Co., Wissinoming

Packing, Flax
Chesterton Co., A. W., Boston
Greene, Tweed & Co., N. Y.

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General Packing Co., Phila.

Packing, Metallic, Flexible
Crane Packing Co., Chicago
France Packing Co., Philadelphia

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Dixon Crucible Co., Jos., Jersey City

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Quigley Furnace Specialties Co., N. Y.

Paints, Industrial
Quigley Furnace Specialties Co., N. Y.
Wailes, Dove & Hermiston Corp., N. Y.

Paints, Rust Proofing
Dearborn Chemical Co., Chicago

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Spang, Chalfant & Co., Inc., Pittsburgh

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Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Limbert & Co., Geo. B., Chicago
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Midwest Piping & Supply Co., St. Louis
Power Piping Co., Pittsburgh

Pipe, Brass & Copper
Foster-Wheeler Corp., N. Y.

Pipe Coils
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Griscom-Russell Co., N. Y.
Midwest Piping & Supply Co., St. Louis
Superheater Co., N. Y.

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Curtis & Curtis Co., Bridgeport
Toledo (Ohio) Pipe Threading Mach. Co.

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Kellogg Co., M. W., N. Y.
Limbert & Co., Geo. B., Chicago
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh

Pipe Hangers and Supports
Limbert & Co., Geo. B., Chicago
Midwest Piping & Supply Co., St. Louis

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Acme Welded Pipe & Coil Co., Jackson
Kellogg Co., M. W., N. Y.
Spang, Chalfant & Co., Inc., Pittsburgh

Pipe, Wrought Steel
Byers Co., A. M., Pittsburgh
Spang, Chalfant & Co., Inc., Pittsburgh

Piping Contractors
Baker Co., R. H., Cambridge
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Limbert & Co. Geo. B., Chicago
National Valve & Mfg. Co., Pittsburgh
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh

Piping, Fabricators
Kellogg Co., M. W., N. Y.
Limbert & Co., Geo. B., Chicago
Reading Iron Co., Reading

Piping, High Pressure
Baker Co., R. H., Cambridge
Byers Co., A. M., Pittsburgh
Kellogg Co., M. W., N. Y.
Limbert & Co., Geo. B., Chicago
National Valve & Mfg. Co., Pittsburgh
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh
Reading Iron Co., Reading
Spang, Chalfant & Co., Inc., Pittsburgh

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Ingersoll-Rand Co., N. Y.

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Stone & Webster, Inc., Boston

Power Plant Management
Stone & Webster, Inc., Boston

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Dodge Mfg. Corp., Miskawaka
Link-Belt Co., Chicago

Pre-Heaters, Air
Air-Preheater Corp., N. Y.
Babcock & Wilcox Co., N. Y.
Buffalo (N. Y.) Forge Co.
Combustion Engineering Corp., N. Y.
Edge Moor (Del.) Iron Co.
Foster Wheeler Corp., N. Y.
Green Fuel Economizer Co., Beacon
International Combustion Engineering Corp., N. Y.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Pulleys
Dodge Mfg. Corp., Mishawaka
Greene, Tweed & Co., N. Y.

Pulverized Coal Equipment
Bethlehem (Pa.) Steel Co.
Combustion Engineering Corp., N. Y.
Foster Wheeler Corp., N. Y.
Fuller Lehigh, Fullerton
International Combustion Engr. Corp., N. Y.
Peabody Engineering Corp., N. Y.
Riley Stoker Corp., Worcester
Streng-Scott Mfg. Co., Minneapolis

Pumps, Air
Chicago Pneumatic Tool Co., N. Y.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., N. Y.
Warren Steam Pump Co., Warren, Mass.
Wheeler Mfg. Co., C. H., Phila.

Pumps, Air Lift
Chicago Pneumatic Tool Co., N. Y.
Ingersoll-Rand Co. N. Y.
Pennsylvania Pump & Compressor Co., Easton, Pa.

Pumps, Boiler Feed
Byron Jackson Pump Co., Berkeley
Ingersoll-Rand Co., N. Y. (A. S. Cameron Steam Pump Works)

Pumps, Centrifugal
Allis-Chalmers Mfg. Co., Milwaukee
Bethlehem (Pa.) Steel Co.
Buffalo Steam Pump Co., Buffalo
Byron Jackson Pump Co., Berkeley
Dayton Dowd Co., Quincy
De Laval Steam Turbine Co., Trenton, N. J.
Economy Pumping Machinery Co., Chicago
Elliott Co., Jeannette, Pa.
Foster-Wheeler Corp., N. Y.
Frederick (Md.) Iron & Steel Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Lecourtenay Co., Newark, N. J.
Manistee (Mich.) Iron Works Co.
Moore Steam Turbine Corp., Wellsville, N. Y.
Nash Engineering So., So. Norwalk
Pennsylvania Pump & Compressor Co., Easton, Pa.
Taber Pump Co., Buffalo
Terry Steam Turbine Co., Hartford
Warren Steam Pump Co., Warren, Mass.
Wheeler Mfg. Co., C. H., Phila.
Worthington Pump & Machinery Corp., N. Y.

Pumps, Condensate
Economy Pumping Machinery Co., Chicago
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co. (Cameron Steam Pump Wks., A. S.), N. Y.

Pumps, Deep Well
Economy Pumping Machinery Co., Chicago
Worthington Pump & Machinery Corp., N. Y.

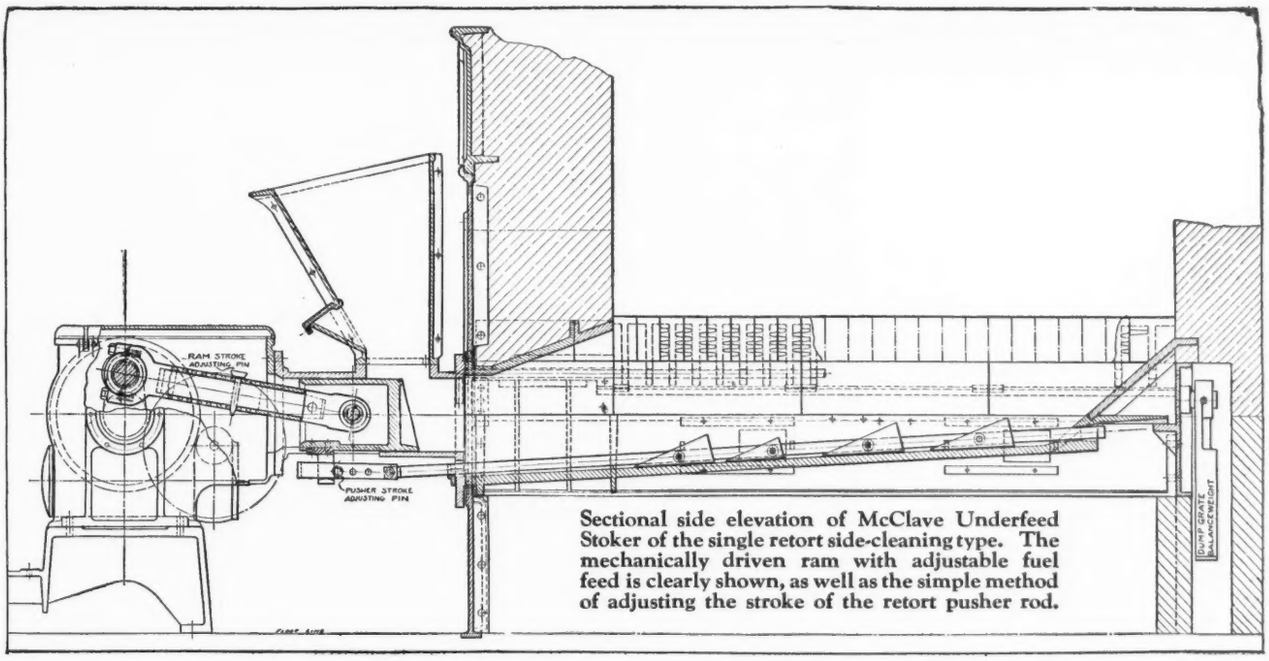
Pumps, Gear
Schutte & Koerting Co., Philadelphia

Pumps, Mine
Economy Pumping Machinery Co., Chicago

Pumps, Oil
Byron Jackson Pump Co., Berkeley
Coen Co., San Francisco
Economy Pumping Machinery Co., Chicago
Hammel Oil Burning Equipt. Co. Providence

Pumps, Power
Economy Pumping Machinery Co., Chicago
Platt Iron Works, Dayton, Ohio
Warren Steam Pump Co., Warren, Mass.
Worthington Pump & Machinery Corp., N. Y.

Pumps, Pulverized Coal
Fuller-Lehigh Co., Fullerton



Sectional side elevation of McClave Underfeed Stoker of the single retort side-cleaning type. The mechanically driven ram with adjustable fuel feed is clearly shown, as well as the simple method of adjusting the stroke of the retort pusher rod.

Simplicity—*the key-note of* McClave Type SR *Underfeed Stoker*

Look at the adjustable fuel feed—the Simple method of adjusting stroke of retort pusher rod—the minimum of moving parts—in fact the entire mechanism is as close to that simplicity which makes for mechanical perfection as is possible.

Simplicity of air-zoning dampers.

Simplicity of entire operation — requiring the minimum of attention.

And designed to simplify firing work and to keep maintenance costs and shut-downs at a minimum.

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McCLAVE STOKERS & GRATES

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Manistee (Mich.) Iron Works Co.
Platt Iron Works, Dayton
Warren Steam Pump Co., Warren, Mass.
Worthington Pump & Machinery Corp., N. Y.

Pumps, Rotary
Taber Pump Co., Buffalo
Wheeler Mfg. Co., C. H., Phila.

Pumps, Sump
Economy Pumping Machinery Co., Chicago
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Sullivan Machinery Co., Chicago

Taber Pump Co., Buffalo
Wheeler Mfg. Co., C. H., Phila.
Worthington Pump & Machinery Corp., N. Y.

Pumps, Underwriters Centrifugal
Economy Pumping Machinery Co., Chicago

Pumps, Vacuum
Economy Pumping Machinery Co., Chicago
Elliott Co., Jeannette, Pa.
Foster-Wheeler Corp., N. Y.
Ingersoll-Rand Co., N. Y., (A. S. Cameron Steam Pump Works)
Warren Steam Pump Co., Warren, Mass.
Wheeler Mfg. Co., C. H., Phila.
Worthington Pump & Machinery Corp., N. Y.

Purifiers, Feed Water
Cochrane Corp., Phila., Pa.
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Hoppes Mfg. Co., Springfield, O.
Permutit Co., N. Y.
Yarnall-Waring Co., Phila., Pa.

Purifiers, Oil
De Laval Separator Co., N. Y.

Purifiers, Steam
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Hagan Corp., Pittsburgh
Marley Co., Kansas City

Pyrometers
Bristol Co., Waterbury
Brown Instrument Co., Phila.
Leeds & Northrup Co., Phila.
Republic Flow Meters Co., Chicago
Superheater Co., N. Y.
Taylor Instrument Co.'s, Rochester

Recorders, Draft
Republic Flow Meters Co., Chicago

Recorders, Flow, Liquid Level, Pressure, Speed, Temperature
Brown Instrument Co., Phila.

Recorders, Gas Density
Permutit Co., N. Y.

Recorders, Pressure
American Schaeffer Budenberg Div. Consolidated Ashcroft Hancock Co., N. Y.
Taylor Instrument Co.'s, Rochester

Refractories
General Refractories Co., Philadelphia
King Refractories Co., Buffalo
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy
Obermayer Co., S., Chicago

Refractory Placing Machines
Cement Gun Co., Allentown
Quigley Furnace Specialties Co., N. Y.

Refractory, Shapes, Special
Babcock & Wilcox Co., N. Y.

Refrigerating Equipment
Acme Welded Pipe & Coil Co., Jackson

Refrigerating Machinery
Ingersoll-Rand Co., N. Y.
Vogt Machine Co., Henry, Louisville

Regulators, Blower
McClave-Brooks Co., Scranton, Pa.

Regulators, Damper, Draft and Fan
Atlas Valve Co., Newark
Hagan Corp., Pittsburgh
Leeds & Northrup Co., Phila.
Powers Regulator Co., Chicago
Smoot Engr. Corp., N. Y.
Watts Regulator Co., Lawrence, Mass.

Regulators, Feed Water
Atlas Valve Co., Newark
Bailey Meter Co., Cleveland
Chaplin-Fulton Mfg. Co., Pittsburgh
Northern Equipment Co., Erie
Skeen & Co., D. H., Chicago
Watts Regulator Co., Lawrence, Mass.

Regulators, Gas
Davis Regulator Co., G. M., Chicago

Regulators, Pressure
Chaplin-Fulton Mfg. Co., Pittsburgh
Crane Co., Chicago
Davis Regulator Co., G. M., Chicago
Northern Equipment Co., Erie
Powers Regulator Co., Chicago
Skeen & Co., D. H., Chicago
Strong, Carlisle & Hammond Co., Cleveland
Taylor Instrument Co.'s, Rochester
Watts Regulator Co., Lawrence, Mass.

Regulators, Pump
Northern Equipment Co., Erie
Skeen & Co., D. H., Chicago
Watts Regulator Co., Lawrence, Mass.

Regulators, Temperature
American Schaeffer Budenberg Div. Consolidated Ashcroft Hancock Co., N. Y.
Brown Instrument Co., Phila.
Powers Regulator Co., Chicago

Resuperheaters
Superheater Co., N. Y.

Rope, Transmission
Hunt Co., C. W., West New Brighton, N. Y.

Rubber Goods
Goodrich Rubber Co., The B. F., Akron
Quaker City Rubber Co., Wissinoming

Rust Preventatives
Dearborn Chemical Co., Chicago

Safety Steps, Steel
Hendrick Mfg. Co., Carbondale
Irving Iron Works Co., Long Island City

Scale Removers
Pierce Co., Wm. B., Buffalo

Scale Removers, Boiler Tube
General Specialty Co., Buffalo
Lagonda Mfg. Co., Springfield, O.
Roto Co., Newark

Scrapers Drag
Beaumont Mfg. Co., Philadelphia

Screens, Perforated Metal
Hendrick Mfg. Co., Carbondale

Screens, Shaking & Revolving
Gruendler Patent Crusher & Pulverizer Co., St. Louis
Robins Conveyor Belt Co., N. Y.

Screens, Water Intake
General Electric Co., Schenectady
Link-Belt Co., Chicago

Second-Hand Equipment (See Searchlight Section)
Consolidated Products Co., Inc.
Crawbuck, J. B.
Fuerst Friedman Co., The
Greenspons Iron & Steel Co.
Higgins, W. E.
Hunt's Sons, M. J.
Industrial Plants Corp.
Johnson, Handley & Johnson Co.
Land, L. J.
Nahville Industrial Corp.
O'Brien Mchy. Co.
Phoenix Utilities Co.
Power Plant Equipment Co.
Randle Machy. Co.
Reading Engine Works
Sachsenmaier, Geo.

Separators, Air, Ammonia, Oil, Steam
Andrews-Bradshaw Co., (Division of Blaw-Knox Co.) Pittsburgh
Cochrane Corp., Phila.
Crane Co., Chicago
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Hoppes Mfg. Co., Springfield, O.
Marley Co., Kansas City
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.
Wright Austin Co., Detroit

Separators, Receiver
Cochrane Corp., Phila.

Sodium, Aluminate
National Aluminate Co., Chicago

Speed Reducers
De Laval Steam Turbine Co., Trenton, N. J.
Dodge Mfg. Corp., Mishawaka
Philadelphia (Pa.) Gear Works

Spray Nozzles
(See Cooling Plants and Ponds)

Stacks, Brick, Radial Brick
Custodis Chimney Constr. Co., Alphons, N. Y.
Kellogg Co., M. W., N. Y.
Rust Engineering Co., Pittsburgh

Stacks, Concrete
Custodis Chimney Construction Co., Alphons, N. Y.
Kellogg Co., M. W., N. Y.
Rust Engineering Co., Pittsburgh

Stacks, Metal
Heine Boiler Co., N. Y.
Prat-Daniel Corp., N. Y.
Union Iron Works, Erie, Pa.

Steam Storage
Ruth Steam Storage Co., N. Y.

Steel Plate Work
Hendrick Mfg. Co., Carbondale
Union Iron Wks., Erie, Pa.

Stokers, Chain and Traveling Grate
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N. Y.
Illinois Stoker Co., Alton
International Combustion Engineering Corp., N. Y.
Johnston & Jennings Co., Cleveland
Laclede Stoker Co., St. Louis, Mo.
McClave-Brooks Co., Scranton, Pa.
Riley Stoker Corp., Worcester

Stokers, Hand Operated
CoKal Stoker Corp., Chicago
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
Flynn & Emrich Co., Baltimore
McClave-Brooks Co., Scranton, Pa.

Stokers, Mechanical
American Engineering Co., Phila.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
Flynn & Emrich Co., Baltimore
Illinois Stoker Co., Alton
International Combustion Engineering Corp., N. Y.
Johnston & Jennings Co., Cleveland
McClave-Brooks Co., Scranton
Riley Stoker Corp., Worcester
Sturtevant Co., B. F., Hyde Park
Westinghouse Electric & Mfg. Co., East Pittsburgh

Stops, Engine
Gas Combustion Co., Pittsburgh
Strong, Carlisle & Hammond Co., Cleveland

Strainers, Oil, Water
Coen Co., San Francisco
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Sarco Co., N. Y.
Strong, Carlisle & Hammond Co., Cleveland

Strainers, Pump Suction
Elliott Co., Jeannette, Pa.

Superheaters
Babcock & Wilcox Co., N. Y.
Foster Wheeler Corp., N. Y.
Marley Co., Kansas City, Mo.
Superheater Co., N. Y.

Switchboards
Westinghouse Electric & Mfg. Co., East Pittsburgh

Tachometers
American Schaeffer Budenberg Div. Consolidated Ashcroft Hancock Co., N. Y.
Biddle, James G., Phila.
Bristol Co., Waterbury
Brown Instrument Co., Phila.
Leeds & Northrup Co., Phila.
Scherr Co., Geo., N. Y.
Zernickow Co., O., N. Y.

Tanks
Cochrane Corp., Phila.
Heine Boiler Co., N. Y.
Union Iron Works, Erie

Tanks, Ash Storage
United Conveyor Corp., Chicago

Tanks, Copper
Hercules Float Wks., Springfield.

Thermometers, Controlling, Indicating, Recording
Consolidated Ashcroft Hancock Co., N. Y.
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Brown Instrument Co., Phila.
Leeds & Northrup Co., Phila.
Taylor Instrument Co.'s, Rochester

Thermometers, Flue Gas
Bailey Meter Co., Cleveland

Transformers
Allis-Chalmers Mfg. Co., Milwaukee

Transmission Machinery
(See Power Transmission Mach.)

Traps, Air, Grease, Non Return, Return, Radiator, Steam, Vacuum
American Schaeffer Budenberg Div. Consolidated Ashcroft Hancock Co., N. Y.
Andrews-Bradshaw Co., Pittsburgh
Armstrong Mach. Works, Three Rivers, Mich.
Cochrane Corp., Phila.
Crane Co., Chicago
Davis Regulator Co., G. M., Chicago
Elliott Co., Jeannette, Pa.
Ellis Drier Co., Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Hobson, R. B., Great Notch, N. J.
Morehead Mfg. Co., Detroit
Nason Mfg. Co., N. Y.
Nicholson & Co., W. H., Wilkes-Barre
Powers Regulator Co., Chicago
Sarco Co., N. Y.
Sterling Engr. & Mfg. Corp., Boston
Strong, Carlisle & Hammond Co., Cleveland
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.
Templeton Mfg. Co., Boston
Trerice Co., H. O., Detroit
Wright Austin Co., Detroit

Tube Cleaners, Boiler
Chesterton Co., A. W., Boston
General Specialty Co., Buffalo
Lagonda Mfg. Co., Springfield, Ohio
Pierce Co., Wm. B., Buffalo
Roto Co., Newark

Tube Cleaners Condenser
Lagonda Mfg. Co., Springfield, Ohio
Pierce Co., Wm. B., Buffalo
Roto Co., Newark

Tube Cutters
Lagonda Mfg. Co., Springfield, Ohio

Tubes, Boiler
Boiler Tube Co., Pittsburgh
Reading Iron Co., Reading
Standard Wire & Tube Co., Mineral Ridge, O.
Tyler Tube & Pipe Co., Washington.

Tubes, Boiler, Charcoal Iron
Tyler Tube & Pipe Co., Washington.

Tubes, Boiler, Lap Welded
Tyler Tube & Pipe Co., Washington

Tubing
Boiler Tube Co., Pittsburgh

Turbines, Steam
Allis-Chalmers Mfg. Co., Milwaukee
Coppus Engineering Corp., Worcester
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford
Westinghouse Electric & Mfg. Co., East Pittsburgh

Turbines, Water
Allis-Chalmers Mfg. Co., Milwaukee

Turbo Generators
Elliott Co., Jeannette, Pa.
Terry Steam Turbine Co., Hartford

Unions and Union Fittings
Crane Co., Chicago
Dart Mfg. Co., E. M., Providence

Vacuum Cleaners
Sturtevant Co., B. F., Hyde Park

Valve Reseating Machine
Leavitt Mach. Co., Orange, Mass.

Valves, Altitude
Golden-Anderson Valve Specialty Co., Pittsburgh

Valves, Ammonia
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Angle
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Automatic Air
Simplex Valve & Meter Co., Phila.
Sterling Engr. & Mfg. Corp., Boston
Templeton Mfg. Co., Boston

Valves, Automatic Cutoff
Elliott Co., Jeannette, Pa.
Golden-Anderson Valve Specialty Co., Pittsburgh

Valves, Back Pressure
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago

Valves Balanced
Davis Regulator Co., G. M., Chicago
Northern Equipment Co., Erie

Swartwout Co., Cleveland
Watts Regulator Co., Lawrence, Mass.

Valves, Blowoff
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Edwards Valve & Mfg. Co., East Chicago
Elliott Co., Jeannette, Pa.
Homestead Valve Mfg. Co., Coraopolis
Templeton Steam Trap Co., N. Y.
Williams Valve Co., D. T., Cincinnati
Yarnall-Waring Co., Phila.

Valves, Brass and Iron Body
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Homestead Valve Mfg. Co., Coraopolis
Kennedy Valve Mfg. Co., Elmira
Michigan Valve & Fdy. Co., Detroit
National Valve & Mfg. Co., Pittsburgh
Pittsburgh (Pa.) Piping & Equip. Co.
Williams Valve Co., D. T., Cincinnati

Valves, Bypass
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Northern Equipment Co., Erie

Valves, Check
Cochrane Corp., Phila.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Davis Regulator Co., G. M., Chicago
Edwards Valve & Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Greene, Tweed & Co., N. Y.
Kennedy Valve Mfg. Co., Elmira

Valves, Electrically Operated
Edwards Valve & Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh

"Here, Lad—

I have your memo about some of my manufacturing friends dividing their purchases of motors between 'Linc-Weld' and whatever type formerly used.

Are you trying to sell me on bigamy? I'm against having more than one make motor just as I'm against having more than one wife."

"Linc-Weld" Superiority is due to:

1. **Larger Shafts**
2. **Larger Bearings**
3. **Better Insulation**
4. **Stronger Frame (Steel)**
5. **Greater Overload Capacity**

"Yes, Pop—

I'm not selling bigamy, but trial preparatory to change. While you can and must put up with some shortcomings from a wife, there's no law to make you stand for it from a servant.

And when a *better* servant is available at the same cost, who doesn't tire, break or require sick leave—then it's inertia only that keeps a man from change.

Now, 'Linc-Weld's' famed overload capacity means that it will work early and late for us on a grind that wilts our present motors.

'Linc-Weld's' complete welded steel construction prevents any breakage — and its double size shafts and bearings, with superinsulation, preclude the time-off-for-repairs that is troubling us.

So, Pop, if I'm selling you bigamy, it's in the same sense that bigamy means one wife too many . . . and for that matter monogamy, in certain instances, is the same thing."

The Lincoln Electric Co., Dept. No. 2-6, Cleveland, Ohio

"Linc-Weld"

M-46

LINCOLN MOTOR

Valves, Exhaust Relief
Davis Regulator Co., G. M., Chicago
Edwards Valve & Mfg. Co., East Chicago
Wheeler Mfg. Co., C. H., Phila.

Valves, Float
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co., Erie
Yarnall-Waring Co., Phila.

Valves, Gate
Consolidated Ashcroft Hancock Co. Inc., N. Y.
Crane Co., Chicago
Greene, Tweed & Co., N. Y.
Kennedy Valve Mfg. Co., Elmira
Pittsburgh (Pa.) Piping & Equip Co.
Wheeler Mfg. Co., C. H., Phila.
Williams Valve Co., D. T., Cincinnati

Valves, Globe
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Edwards Valve & Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Kennedy Valve Mfg. Co., Elmira
Strong, Carlisle & Hammond Co., Cleveland
Williams Valve Co., D. T., Cincinnati

Valves, Hydraulic
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Homestead Valve Mfg. Co., Coraopolis
Kennedy Valve Mfg. Co., Elmira
Swartwout Co., Cleveland
Vogt Machine Co., Henry, Louisville
Williams Valve Co., D. T., Cincinnati
Yarnall-Waring Co., Phila.

Valves, Non-Return Stop
Edwards Valve & Mfg. Co., East Chicago
Elliott Co., Jeannette, Pa.
Golden-Anderson Valve Specialty Co., Pittsburgh
Strong, Carlisle & Hammond Co., Cleveland

Valves, Pop, Safety
Consolidated Ashcroft Hancock Co. Inc., N. Y.

Valves, Pump Rubber
Jenkins Bros., N. Y.

Valves, Reducing
Davis Regulator Co., G. M., Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co., Erie
Schutte & Koerting Co., Philadelphia
Swartwout Co., Cleveland

Templeton Steam Trap Co., N. Y.
Watts Regulator Co., Lawrence, Mass.

Valves, Regrinding
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Williams Valve Co., D. T., Cincinnati

Valves, Regulating
Atlas Valve Co., Newark
Bristol Co., Waterbury
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co., Erie
Powers Regulator Co., Chicago
Simplex Valve & Meter Co., Phila.
Swartwout Co., Cleveland

Valves, Relief
American Schaeffer Budenberg Div. Consolidated Ashcroft Hancock Co., N. Y.
Cochrane Corp., Phila.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co., Erie
Swartwout Co., Cleveland

Valves, Safety
American Schaeffer Budenberg Div. Inc., N. Y.
Consolidated Ashcroft Hancock Co., N. Y.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh

Valves, Steel
Edwards Valve & Mfg. Co., East Chicago

Valves, Stop Check
Edwards Valve & Mfg. Co., East Chicago
Elliott Co., Jeannette, Pa.
Schutte & Koerting Co., Philadelphia

Valves, Superheated Steam
Consolidated Ashcroft Hancock Co.
Edwards Valve & Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Vogt Machine Co., Henry, Louisville

Valves, Two, Three and Four-Way
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Valves, Throttle
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Edwards Valve & Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Schutte-Koerting Co., Phila.

Valves, Vacuum
Sarco Co., N. Y.

Ventilators
Burt Mfg. Co., Akron
Sturtevant Co., B. F., Hyde Park

Vises
Curtis & Curtis Co., Bridgeport
Toledo (Ohio) Pipe Threading Machine Co.

Walls, Water
Riley Stoker Corp., Worcester

Waterbacks, High & Low Pressure
Foster-Wheeler Corp., N. Y.
McClave-Brooks Co., Scranton

Water Column
Golden-Anderson Valve Specialty Co., Pittsburgh

Water Columns, Alarm Type
Wright Austin Co., Detroit
Yarnall-Waring Co., Philadelphia

Waterproofing
Carey Co., Philip, Lockland

Water Purifying Apparatus
Cochrane Corp., Phila.
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Paramount Water Softener Co., N.Y.
Permutit Co., N. Y.
Scaife, Wm. B. & Sons Co., Oakmont, Pa.

Water Softening Apparatus
Cochrane Corp., Phila.
National Aluminate Co., Chicago
Paramount Water Softener Co., N.Y.
Permutit Co., N. Y.

Water Testing Equipment
Griscom-Russell Co., N. Y.

Water Treatment, Feed
Dearborn Chemical Co., Chicago
National Aluminate Co., Chicago
Permutit Co., N. Y.

Water Walls
Edge Moor (Del.) Iron Co.

Water Wheels
Allis-Chalmers Mfg. Co., Milwaukee

Welders, Arc
Lincoln Electric Co., Cleveland

Welders, Automatic Electric
Lincoln Electric Co., Cleveland

Wire, Welding
Lincoln Electric Co., Cleveland

Wrenches
Greene, Tweed & Co., N. Y.

"SEARCHLIGHT" is the "OPPORTUNITY"

advertising of this industry.

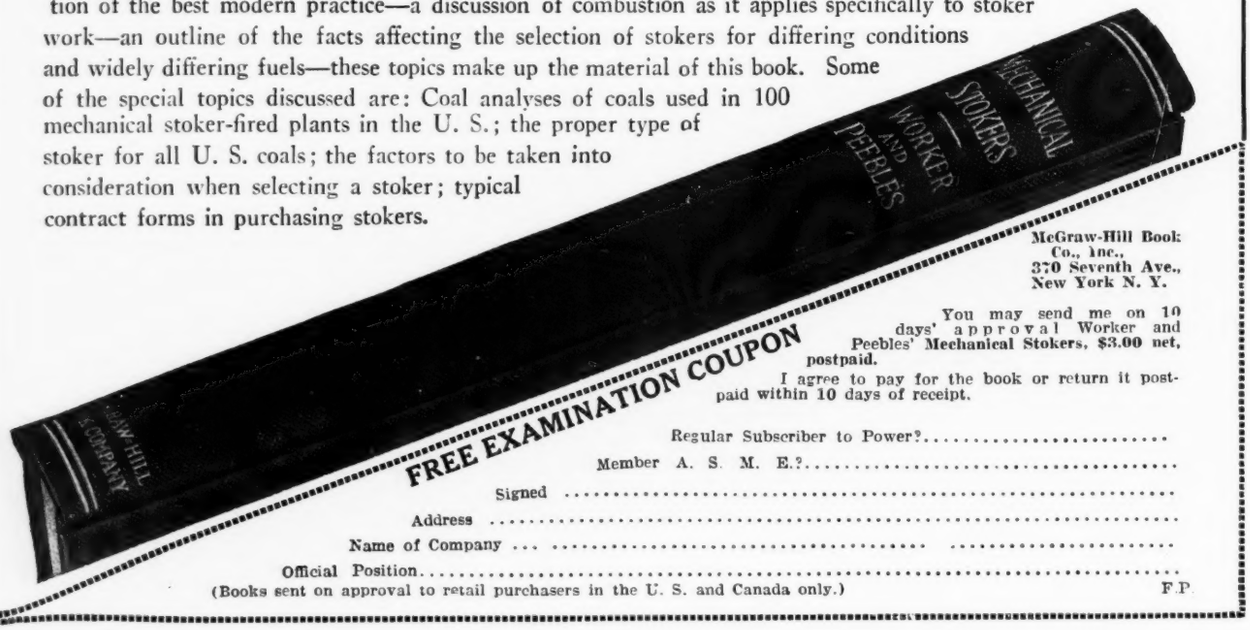
0095

Facts

on the design, installation and operation of

Mechanical Stokers

This book—Worker and Peebles' MECHANICAL STOKERS ($3.00)—gives reliable unbiased opinions and facts from actual field experience in the design, installation and operation of stokers—a sound presentation of the best modern practice—a discussion of combustion as it applies specifically to stoker work—an outline of the facts affecting the selection of stokers for differing conditions and widely differing fuels—these topics make up the material of this book. Some of the special topics discussed are: Coal analyses of coals used in 100 mechanical stoker-fired plants in the U. S.; the proper type of stoker for all U. S. coals; the factors to be taken into consideration when selecting a stoker; typical contract forms in purchasing stokers.



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370 Seventh Ave.,
New York N. Y.

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I agree to pay for the book or return it postpaid within 10 days of receipt.

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Member A. S. M. E.?.....

Signed .....

Address .....

Name of Company ... .

Official Position.....

(Books sent on approval to retail purchasers in the U. S. and Canada only.) F.P.

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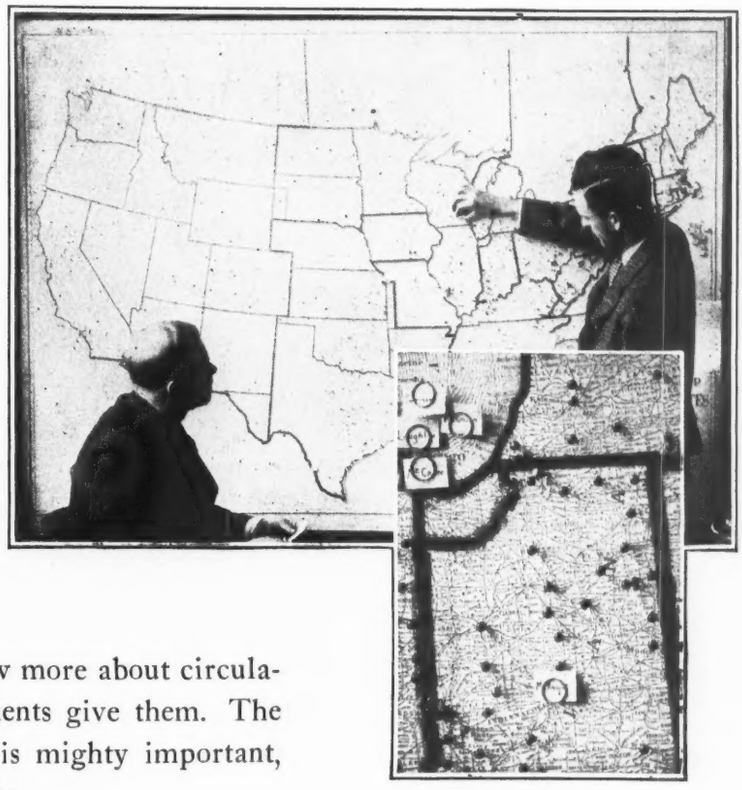
Behind the scenes of circulation building



ADVERTISERS need to know more about circulation than circulation statements give them. The method of building circulation is mighty important, as the following questions suggest:

How do publishers locate and rate subscribing prospects? How do they get them? Why do they get them?

At McGraw-Hill circulation headquarters in New York there is a large map shown on this page. On it here and there are colored pegs which show what circulation we do not have—plants, utilities or service organizations whose buying power should be covered by a McGraw-Hill publication.

No one—publisher or manufacturer—can map his prospects in this way without continuous research.

Between 50 and 60 salaried McGraw-Hill circulation men participate in this research to locate, rate and get only the decision men of industry and business.

The McGraw-Hill circulation man is trained to help the reader subscribe to the publication that deals most intimately with his daily problems. That is why his card is open-sesame in important industrial plants throughout the country, whose policy is "no book agents admitted."

—The publishers

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This index is published as a convenience to the reader. Every care is taken to make it accurate, but POWER assumes no responsibility for errors or omissions.

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